EAST Search History

Ref #	Hits	Search Query	DBs	Default Operator	Plurals	Time Stamp
L1	1	"7128882".pn.	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 17:39
L2	1	"6942841".pn.	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 17:44
L3	11661	705/1,7,8,9,400,500.ccls.	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:29
L4	236	(perfluoride$1 or perfluorocompound$1) and (treatment or treating or processing or decompostion or decomposing)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:27
L5	19	(perfluoride$1 or perfluorocompound$1) and ((treatment or treating or processing or decompostion or decomposing) with cost)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 17:50
L6	24	(perfluoride$1 or perfluorocompound$1) and ((treatment or treating or processing or decompostion or decomposing) with cost)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:09
L7	236	(perfluoride$1 or perfluorocompound$1) and (treatment or treating or processing or decompostion or decomposing)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 17:50
L8	0	(calculat$3 or determin$3 or estimat$3) with cost with (treatment near3 fluoride$1)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 17:52
L9	0	(calculat$3 or determin$3 or estimat$3) with cost with (treat$3 near3 fluoride$1)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 17:52

EAST Search History

L10	4	(calculat$3 or determin$3 or estimat$3) with cost with fluoride$1	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 17:53
L11	3	(calculat$3 or determin$3 or estimat$3) with cost with (perfluoride$1 or perfluorocompound$1)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 17:53
L12	3	11 not 10	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:03
L13	2	install$ with (perfluoride$1 or perfluorocompound$1) with (treat$3 or treatment)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:08
L14	0	install$ with (perfluoride$1 or perfluorocompound$1) with (independent or (third adj party))	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:07
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L16	0	(perfluoride$1 or perfluorocompound$1) with (treat$3 or treatment) with (independent or (third adj party))	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:08
L17	2	((perfluoride$1 or perfluorocompound$1) with (treat$3 or treatment)) and (independent or (third adj party))	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:08
L19	3	(independent or (third adj party)) and 6	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:27

EAST Search History

L20	1735485	(Perfluorocompound$1 or PFC) or ((chlorine adj free) near4 compound$1) or (carbon or fluorine or hydrogen or sulfur or nitrogen or CF4 or CHF3 or C2F6 or CH2F2 or C3F8 or CsFs or SFG or NF3)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:25
L21	23	6 and 20	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:25
L22	0	3 and 21	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:26
L23	51632	"705"/$7.ccls.	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:26
L24	0	21 and 23	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:26
L25	1005	23 and 20	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:26
L26	0	6 and 25	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:27
L27	777	25 and (bill$3 or charging or fee or account$3)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:27
L28	500	(independent or (third adj party)) and 27	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	ON	2007/07/07 18:27

EAST Search History

L29	3580936	(treatment or treating or processing or decompostion or decomposing)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:28
L30	474	28 and 29	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:28
L31	504288	(treatment or treating or processing or decompostion or decomposing) with (equipment or apparatus)	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:28
L32	125	30 and 31	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:28
L33	1384	422/168.ccls.	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:28
L34	2433	423/235,240R.ccls.	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:29
L35	3751	33 or 34	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:29
L36	0	32 and 35	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:29
L37	18651	705/26,27,29-42.ccls.	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:30
L38	33	32 and 37	US-PGPUB; USPAT; FPRS; EPO; JPO; IBM_TDB	OR	OFF	2007/07/07 18:30

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 (Dialog time 2007/07/07 17:49:24)

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10,613,621,624,634,636,810,813
IGORMEDIC is set ON as an alias for
5,34,42,43,73,74,129,130,149,155,442,444,455
IGORINSUR is set ON as an alias for 169,625,637
IGORBANK is set ON as an alias for 139,267,268,625,626
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IGORSHOPCOUPON is set ON as an alias for 47,570,635,PAPERSMJ,PAPERSEU
IGORINVEN is set ON as an alias for 6,7,8,14,34,94,434
IGORFUNDTRANS is set ON as an alias for 608
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  File  20:Dialog Global Reporter 1997-2007/Jul 07
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  File  35:Dissertation Abs Online 1861-2007/Jun
        (c) 2007 ProQuest Info&Learning
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        (c) 2007 The HW Wilson Co.
  File 148:Gale Group Trade & Industry DB 1976-2007/Jul 04
        (c)2007 The Gale Group
*File 148: The CURRENT feature is not working in File 148.
See HELP NEWS148.
  File 160:Gale Group PROMT(R) 1972-1989
        (c) 1999 The Gale Group
  File 256:TecInfoSource 82-2007/June
        (c) 2007 Info.Sources Inc
  File 275:Gale Group Computer DB(TM) 1983-2007/Jul 04
        (c) 2007 The Gale Group
  File 347:JAPIO Dec 1976-2007/Dec(Updated 070702)
        (c) 2007 JPO & JAPIO
  File 348:EUROPEAN PATENTS 1978-2007/ 200727
        (c) 2007 European Patent Office
*File 348: For important information about IPCR/8 and forthcoming
changes to the IC= index, see HELP NEWSIPCR.
  File 349:PCT FULLTEXT 1979-2007/UB=20070705UT=20070628
        (c) 2007 WIPO/Thomson
*File 349: For important information about IPCR/8 and forthcoming
changes to the IC= index, see HELP NEWSIPCR.
  File 474:New York Times Abs 1969-2007/Jul 07
        (c) 2007 The New York Times
  File 475:Wall Street Journal Abs 1973-2007/Jul 07
        (c) 2007 The New York Times
  File 476:Financial Times Fulltext 1982-2007/Jul 07
        (c) 2007 Financial Times Ltd
  File 583:Gale Group Globalbase(TM) 1986-2002/Dec 13
        (c) 2002 The Gale Group
*File 583: This file is no longer updating as of 12-13-2002.
  File 610:Business Wire 1999-2007/Jul 07
        (c) 2007 Business Wire.
*File 610: File 610 now contains data from 3/99 forward.
Archive data (1986-2/99) is available in File 810.
  File 613:PR Newswire 1999-2007/Jul 07
        (c) 2007 PR Newswire Association Inc
*File 613: File 613 now contains data from 5/99 forward.
Archive data (1987-4/99) is available in File 813.
  File 621:Gale Group New Prod.Annou.(R) 1985-2007/Jul 04
        (c) 2007 The Gale Group
  File 624:McGraw-Hill Publications 1985-2007/Jul 06
        (c) 2007 McGraw-Hill Co. Inc
*File 624: Homeland Security & Defense and 9 Platt energy journals added
Please see HELP NEWS624 for more
  File 634:San Jose Mercury  Jun 1985-2007/Jul 01
        (c) 2007 San Jose Mercury News
  File 636:Gale Group Newsletter DB(TM) 1987-2007/Jul 04
        (c) 2007 The Gale Group
  File 810:Business Wire 1986-1999/Feb 28
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        (c) 1999 Business Wire
  File 813:PR Newswire 1987-1999/Apr 30
        (c) 1999 PR Newswire Association Inc

      Set  Items  Description
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? S (perfluoride? or perfluorocompound?) and (treatment or treating or processing or decompostion or decomposing)

Processing

```
             64  PERFLUORIDE?
            542  PERFLUOROCOMPOUND?
        4713349  TREATMENT
        1133631  TREATING
        7464333  PROCESSING
            327  DECOMPOSTION
          53734  DECOMPOSING
      S1    236  (PERFLUORIDE? OR PERFLUOROCOMPOUND?) AND (TREATMENT OR
               TREATING OR PROCESSING OR DECOMPOSTION OR DECOMPOSING )
```

? S (treatment or treating or processing or decompostion or decomposing) with (equipment or apparatus)

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>>>Invalid syntax
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? S (treatment or treating or processing or decompostion or decomposing) (W) (equipment or apparatus)

Processing
Processing
Processing
Processing
Processing

```
Processing
Processed  10 of  27 files ...
Processing
Processed  20 of  27 files ...
Completed processing all files
        4713349  TREATMENT
        1133631  TREATING
        7464333  PROCESSING
            327  DECOMPOSTION
          53734  DECOMPOSING
       15026609  EQUIPMENT
        2376428  APPARATUS
      S2 197048  (TREATMENT OR TREATING OR PROCESSING OR DECOMPOSTION OR
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? **S S1 AND S2 and (cost or billing)**

```
          236  S1
       197048  S2
     14007630  COST
       692064  BILLING
S3        17  S1 AND S2 AND (COST OR BILLING)
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? **s s1 and s2**

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          236  S1
       197048  S2
S4        31  S1 AND S2
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? **s (independent or (third adj party)) and s4**

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       7614480  INDEPENDENT
             0  THIRD ADJ PARTY
            31  S4
S5           9  (INDEPENDENT OR (THIRD ADJ PARTY)) AND S4
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? **s s5 and (bill??? or charging or fee or account???)**

Processing
Processing
Processing
Processing
Processing

```
Processing
Processed  10 of  27 files ...
Processing
Completed processing all files
              9  S5
       15390582  BILL???
         677185  CHARGING
        1866786  FEE
       13417268  ACCOUNT???
S6            6  S5 AND (BILL??? OR CHARGING OR FEE OR ACCOUNT???)
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? **t s6/3,k/1-6**

DIALOG(R)File 348: EUROPEAN PATENTS

6/3K/1
02227619

Method and apparatus for treating perflourocompound gas

Verfahren und Vorrichtung zur Behandlung von Perfluoroverbindungen enthaltenden Gasen
Procede et dispositif pour le traitement de gaz contenant des composants perfluoros
Method and apparatus for **treating** perflourocompound gas

Patent Assignee:

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  (Applicant designated States: all)

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Legal Representative:

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	Country	Number	Kind	Date	
Patent	EP	1775012	A2	20070418	(Basic)
	EP	1775012	A3	20070704	
Application	EP	2006014586		20001123	
Priorities	JP	99335468		19991126	

Designated States:
DE; FR; NL;

Related Parent Numbers: Patent (Application):EP 1103297 (EP 2000125243)

International Classification (Version 8)

IPC	Level	Value	Position	Status	Version	Action	Source	Office

B01D-0053/70	A	I	F	B	20060101	20070222	H	EP
B01D-0053/68	A	I	L	B	20060101	20070222	H	EP
B01D-0053/86	A	I	L	B	20060101	20070222	H	EP

Abstract ...A3

Abstract Word Count: 114
NOTE: 1
NOTE: Figure number on first page: 1

Legal Status

Type	Pub. Date	Kind	Text

Language

Publication: English
Procedural: English
Application: English

Fulltext Availability

Available Text	Language	Update	Word Count
CLAIMS A	(English)	200716	718
SPEC A	(English)	200716	5224
Total Word Count (Document A) 5944			
Total Word Count (Document B) 0			
Total Word Count (All Documents) 5944			

Specification: ...BACKGROUND OF THE INVENTION

The present invention relates to a method and an apparatus for **treating perfluorocompound** (PFC) gas.

PFC is a general term for CF4)), C2))F6)), C3))F8)), SF6)), NF3 ... ...ID=PCIT0001 DNUM=JP11070322A> JP-A-11-70322 (1999 </PATCIT>).

During study of the PFC **treating** method, wherein the PFC gas is decomposed, the decomposed gas is washed, and the washed... ...exhaust pipes by the washed decomposed PFC gas in the method or the apparatus for **treating** the decomposed PFC gas.

The gist of the present invention is separating mist containing PFC... ...JP11216455A> JP-A-11-216455 (1999 </PATCIT>), but this prior art does not relate to **treating** decomposed PFC gas. <PATCIT ID=PCIT0003 DNUM=JP8318122A> JP-A-8-318122 (1996 </PATCIT>) and... ...used after water washing of the gas, but this prior art does not relate to **treating** a corrosive mist of decomposed PFC gas, neither.

<PATCIT ID=PCIT0005 DNUM=US5955037A> US 5 955 037 </PATCIT> discloses a method and an

apparatus for the **treatment** of gaseous effluents such as waste gases from semiconductor manufacturing operations. The system comprises a... ...comprise a scrubber, an oxidation unit such as an electrothermal oxidizer, and a post-oxidation **treatment** unit, such as a wet or dry scrubber. It is mentioned in the description of this document (column 11, 2nd paragraph) that the constituent **treatment** units may include an oxidizer which can be, inter alia, a catalytic oxidizer. The system... ...from the gas released from gas washing.

The above problem is solved according to the **independent** claims. The dependent claims relate to preferred embodiments of the invention.

The method of the invention of **treating perfluorocompound** (PFC) gas comprising perfluorinated compounds comprises the steps of

1. (A) **decomposing** the PFC gas,

2. (B) washing the resulting gas with a washing liquid of water... ...is preferably composed of Al2))O3)) and Pd, La.

The apparatus of the invention for **treating perfluorocompound** (PFC) gas comprising perfluorinated compounds comprises

a PFC decomposition apparatus for **decomposing** PFC gas,

a gas washing apparatus for washing the decomposed gas with a washing liquid... ...characterized in that

the PFC decomposition apparatus comprises

1. (a) a PFC decomposition catalyst for **decomposing** the PFC gas by hydrolysis, oxidation decomposition, combustion or thermal decomposition

and

2. (b) a... ...OF THE DRAWINGS

FIG. 1 is a schematic illustration indicating an example of the PFC **treating apparatus** relating to the present invention installed with a semiconductor etching oven,

FIG. 2A is a... ...collector collects the mist from a gas flowing in a strong electric field by electrostatic **charging**, and the mist is collected at an opposite electrode portion. A schematic cross section of... ...19. The waste water 20 can be made harmless by a ready-made waste water **treating** facility in the semiconductor factory. The mist separated by the cyclone can also be stored... ...the exhaust gas blower is similar to that of the exhaust gas pipe.

Embodiment 1

Treatment of SF6)) was performed by the PFC **treatment apparatus** illustrated in FIG. 1 except the etching oven 99, the packed tower 101, and the... ...discharge electrode and the dust collecting electrode.

As the result of performing the SF6)) decomposition **treatment** similarly as in embodiment 1 using 8 kV, the SO3)) concentration at the outlet of... ...are provided downstream of the decomposed gas

washing tower, can be suppressed in PFC gas **treatment**.

Claims: ...A2

1. Method of **treating perfluorocompound** (PFC) gas comprising perfluorinated compounds,

comprising(A) <B>decomposing</B> the PFC gas,

(B) washing the resulting gas with a washing liquid of water or... ...removing catalyst (9) used is composed of Al2))O3)) and Pd, La.

8. Apparatus for **treating perfluorocompound** (PFC) gas comprising perfluorinated compounds,

comprising- a PFC decomposition apparatus (1) for <B>decomposing</B> PFC gas,

- a gas washing apparatus (13) for washing the decomposed gas with a washing... ...in that

the PFC decomposition apparatus (1) comprises(a) a PFC decomposition catalyst (8) for <B>decomposing</B> the PFC gas by hydrolysis, oxidation decomposition, combustion or thermal decomposition

and

(b) a hazardous...

DIALOG(R)File 348: EUROPEAN PATENTS

6/3K/2
01340702

Method and apparatus for reducing perfluorocompound gases from substrate processing equipment emissions
Verfahren und Vorrichrung zur Reduzierung von Gasen bestehend aus Perfluoroverbindungen in Abgasen von einer Substrat-Bearbeitungsvorrichtung
Methode et procede de reduction du taux de composes pefluores dans des effluents de traitement de substrat
Method and apparatus for reducing **perfluorocompound** gases from substrate **processing equipment** emissions

Patent Assignee:

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  (Proprietor designated states: all)

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- **Taylor, William N., Jr.**
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- **Fodor, Mark**
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- **Fairbairn, Kevin**
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Legal Representative:

- **Kirschner, Klaus Dieter, Dipl.-Phys. (6506)**
  Schneiders & Behrendt Rechtsanwalte - Patentanwalte Sollner Strasse 38; 81479 Munchen; (DE)

	Country	Number	Kind	Date	
Patent	EP	1145759	A1	20011017	(Basic)
	EP	1145759	B1	20040421	
Application	EP	2001106259		19961224	
Priorities	US	579375		19951227	
	US	741272		19961030	

Designated States:
DE; GB;

Related Parent Numbers: Patent (Application):EP 781599 (EP 96309542)

International Patent Class (V7): B01J-012/00; C23C-016/44; B01J-019/08; B01D-053/32

Abstract ...A1

Abstract Word Count: 139
NOTE: 1
NOTE: Figure number on first page: 1

Legal Status

Type	Pub. Date	Kind	Text

Language
Publication: English
Procedural: English

Application: English

Fulltext Availability

Available Text	Language	Update	Word Count
CLAIMS A	(English)	200142	756
SPEC A	(English)	200142	23185
CLAIMS B	(English)	200417	797
CLAIMS B	(German)	200417	740
CLAIMS B	(French)	200417	858
SPEC B	(English)	200417	16632
Total Word Count (Document A) 23945			
Total Word Count (Document B) 19027			
Total Word Count (All Documents) 42972			

Specification: ...A1

The present invention relates generally to the field of semiconductor **processing equipment** and more specifically to a method and apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and to a method and apparatus for reducing **perfluorocompound** (PFC) gas emissions from a **processing** chamber.

During chemical vapor deposition (CVD) **processing**, deposition gases are released inside a **processing** chamber to form a thin film layer on the surface of a substrate being processed. Unwanted deposition on areas such as the walls of the **processing** chamber also occurs during such CVD processes. Because the residence time in the chamber of... ...life of the pump. Also, the solid matter may backwash from the foreline into the **processing** chamber and contaminate **processing** steps adversely effecting wafer yield.

To avoid these problems, the inside surface of the foreline... ...employed to remove unwanted deposition material from the chamber walls and similar areas of the **processing** chamber. Common chamber cleaning techniques include the use of an etching gas, such as fluorine ... ...deposition material from the foreline is more difficult because the foreline is downstream from the **processing** chamber. In a fixed time period, most points within the **processing** chamber come in contact with more of the etchant fluorine atoms than do points within ... ...a need for an apparatus for efficiently and thoroughly cleaning the foreline in a semiconductor **processing** system and a method of doing the same.

One approach that has been employed to... ...for cleaning a foreline is desirable.

Another issue of concern in CVD and other substrate **processing apparatus** relates to the types of gases and byproducts exhausted from the **processing** chamber through the foreline. For example, because dissociation of gas within the cleaning plasma is... ...containing gases employed in the semiconductor industry as cleaning etchant gases are referred to as **perfluorocompounds** or "PFC's" for short. Some of the more commonly used PFC's include CF4... ...of government and other regulations. Accordingly, it is important to reduce PFC emissions from semiconductor **processing equipment** such as CVD reaction chambers.

The present invention solves the above problems of the prior... ...matter and other residual material from

building up in an exhaust line of a substrate **processing** chamber and/or reducing PFC emissions from such a chamber. Different embodiments of the present... ...an embodiment optimized for both particle and PFC emissions reduction for use with certain substrate **processing** operations.

The present invention achieves these goals while being process transparent. That is, in preferred embodiments, operation of the present invention takes no additional **processing** time to either prevent particulate matter from building up within the foreline or reduce PFC ... ...particulate matter that would otherwise collect in the vacuum line when exhausted from a substrate **processing** chamber (e.g., during a CVD step) are trapped in the gas passageway. The apparatus...other embodiments, the present invention is designed and optimized to reduce PFC emissions from semiconductor **processing equipment**. One embodiment of such an apparatus includes a vessel chamber that defines a fluid conduit... ...and collection system reduces particle build up within an exhaust line connected to a substrate **processing** chamber and the collected particles and residue provides the PFC oxidizing agent. The particle trapping... ...during an experiment designed to test one embodiment of the present invention.

I. Exemplary Semiconductor **Processing** Chamber

The apparatus of the present invention can be used in conjunction with a variety of different semiconductor **processing** devices. One suitable device, a chemical vapor deposition machine, is shown in Fig. 1 which... ...12) can be controllably moved between a lower loading/off-loading position and an upper **processing** position 14 which is closely adjacent manifold 11.

When susceptor 12 and the wafer are in **processing** position 14, they are surrounded by a baffle plate 17 having a plurality of spaced holes 23 which exhaust into an annular vacuum manifold 24. During **processing**, gas inlet to manifold 11 is uniformly distributed radially across the surface of the wafer... ...heating for effecting deposition.

A motor, not shown, raises and lowers susceptor 12 between a **processing** position 14 and a lower, wafer-loading position. The motor, gas supply valves (not shown... ...used with thermal CVD devices, plasma etching devices, physical vapor deposition devices and other substrate **processing** devices. The apparatus of the present invention and the method for preventing deposition build-up within a vacuum line is not limited to any specific semiconductor **processing apparatus** or to any specific deposition or etching process or method.

II. Exemplary Uses of the Present Invention

During semiconductor **processing** operations such as chemical vapor deposition processes carried out by CVD reactor 10, a variety... ...the apparatus of the present invention is positioned downstream from the exhaust gas source -- the **processing** chamber. The apparatus may either connect to or replace a portion of the vacuum foreline... ...power supplies or may both be driven from the main RF power supply connected to **processing** chamber 10.

Such a two-DPA configuration may also be used to employ two DPAs... ...the inventors are aware, silane-based silicon nitride CVD deposition operations are among the substrate **processing** operations that generate the most particles. Other substrate **processing** operations may also generate particle build-up and residue, however. For example, similar residues are... ...Fig. 4(a)). DPA 40 is connected to the foreline (or directly connected to the **processing** chamber) through coupling mechanisms 64 and 66 (Fig 4(a)). For example, in one embodiment... ...at coupling mechanism 66. Gases and particulate matter exhausted into the foreline from the substrate **processing** chamber pass into DPA 40 through inlet 50

and exit from outlet 52.

A removable... ...effluent gas stream, e.g., particles generated during a substrate deposition or other type of **processing** step. Each particle collection area 62 is a "U"-shaped segment of the gas passageway... ...can be a separate RF power supply that drives only DPA 40. Additionally, assuming multiple **processing** chambers are present in a clean room, the multiple DPAs connected to the chambers may...through connection 68.

In standard operation, DC power is supplied to electrode 56 during substrate **processing** steps, such as a CVD step, to enhance the particle trapping capabilities of DPA 40... ...effective trapping mechanism. Such DC voltage can be applied at all times during chamber operation (**processing** and clean steps) or may be stopped during the chamber clean operation when DPA 40 is activated.

In one substrate **processing** operation, where silicon nitride was deposited from a process gas of SiH4)), N2)) and NH3... ...DC field within DPA 40 provided an optimal electrostatic collector for use with this substrate **processing** operation.

In Fig. 6, line 110 represents the total accumulation of negatively-charged particles collected... ...with the particles and residue trapped within the DPA from one or more previous substrate **processing** steps. Preferably, the application of RF energy to form this plasma is discontinued during times... ...supplied to the DPA during a clean sequence only, during a deposition or other substrate **processing** step only, or it could be continuously supplied during both deposition and clean cycles. In an embodiment where the etchant gas is supplied to the DPA during a substrate **processing** step, RF energy is applied to electrode 56 during the substrate **processing** step to form a plasma and further etch deposited material from within the DPA.

The... ...upstream of the DPA to control chamber pressure and one downstream to control DPA pressure **independent** of the pressure within the **processing** chamber.

Without a throttle valve downstream of the DPA, the pressure within the DPA is... ...the pressure of the foreline (between about 0.8-2.5 torr in some PECVD **processing** apparatuses operated at about 4.5-6 torr). With a throttle valve downstream from the... ...53 sends a signal to processor 34 to turn OFF both the DPA and substrate **processing** chamber 10. In a preferred embodiment, switch 53 is a half-atmosphere switch that initiates... ...fourth side (the backside) of the DPA is placed directly against part of the substrate **processing** chamber. The degree of cooling provided by fins 69 depends on the size of the... ...of the DPA, experiments were performed to determine the composition of residue deposited in the **processing** chamber by a silicon nitride deposition step followed by a fluorine clean step. The composition... ...residue samples were collected: powder collected in the foreline approximately 0.5 m downstream the **processing** chamber immediately after an Si3))N4)) deposition step as described above (sample A); powder collected... ...in the first meters of the foreline. This white powder presents a high F content, **accounting** for the transformation of Six))Ny))Hz)) into (NH4)))2))SiF6)) (ammonium hexafluoro silicate, which... ...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994), which is hereby incorporated by reference.

The helical... ...coil. In Fig. 11, DPA 40 includes a tube 150 through which exhaust gases from **processing** chamber 15 flow as they pass through the DPA. Tube 150 is a cylindrical tube...are able to collect and trap 99.9% of all particulate matter exhausted from the **processing** chamber making length a less important factor. Because the length of the coil should be... ...described that DPA 40 is preferably turned ON and OFF during specific periods of a **processing** procedure, the DPA may also be configured

as a passive device. As a passive device... ...405b.

Electrodes 402 and 404 define a gas passageway 405 through which gases exhausted from **processing** chamber 15 pass. Electrode 402 is grounded while RF and DC power is applied to... ...outlet 403.

If appropriate, a DC filter 412 can be positioned between DPA 40 and **processing** chamber 15 so that the voltage applied to the DPA to help trap electrically charged matter in the effluent gas stream does not interfere with substrate **processing** operations occurring within the chamber.

A diagram showing the electrical circuit that includes electrodes 402... ...452 to provide an electrostatic collector as previously described during a deposition or other substrate **processing** operation. DC power to electrode 452 is switched OFF (by a switch not shown) and... ...135 seconds and the DPA was driven at 200 Watts. CF4)) was introduced into the **processing** chamber at a rate of 1500 sccm and mixed with N2))O introduced into the... ...which the DPA was driven was increased to 500 Watts. CF4)) was introduced into the **processing** chamber at a rate of 2000 sccm and mixed with N2))O introduced into the... ...driven was increased to 500 Watts. The rate at which CF4)) was introduced into the **processing** chamber was increased to 2500 sccm and mixed with N2))O introduced into the chamber... ...chamber 15 and to any process where a PFC gas is a byproduct of the **processing** operation performed in chamber 15. Additionally, the present invention may be used to reduce emission...less expensive to operation than higher RF frequencies such as 13.56 MHz. Assuming multiple **processing** chambers are present in a clean room, the multiple PR2)s connected to the chambers... ...filters, however, may be able to convert substantially all the PFC gases exhausted from the **processing** chamber into less harmful gases making length and volume less important factors.

A number of... ...240. In Fig. 21, PR2) 240 includes a tube 250 through which exhaust gases from **processing** chamber 15 flow as they pass through PR2) 240. Tube 250 is a cylindrical tube... ...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994), which is hereby incorporated by reference. The helical... ...serves at least two purposes. First, it acts as a Faraday cage and shields CVD **processing** **apparatus** 10 and other equipment from the radiation generated by coil 252. Second, if ceramic tube... ...can range from 100-500 millitorr (base foreline pressure) up to,the pressure within the **processing** chamber (4-20 torr in the case of a PECVD process and up to 700... ...electrodes 320 and 322 define a gas passageway (fluid conduit) through which gases exhausted from **processing** chamber 15 pass. Module 310 includes both electrostatic and mechanical trapping mechanisms to ensure that...many other equivalent or alternative devices for and methods of reducing PFC emissions from a **processing** chamber according to the present invention will be apparent to those skilled in the art...

Specification: ...B1

The present invention relates generally to the field of semiconductor **processing equipment** and more specifically to a method and apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and to a method and apparatus for reducing **perfluorocompound** (PFC) gas emissions from a **processing** chamber.

During chemical vapor deposition (CVD) **processing**, deposition gases are released inside a **processing** chamber to form a thin film layer on the surface of a substrate being processed. Unwanted deposition on areas such as the walls of the **processing** chamber also occurs during such CVD processes. Because the residence time in the chamber of... ...life of the pump. Also, the solid matter may backwash from the foreline into the **processing** chamber and contaminate **processing** steps adversely effecting wafer yield.

To avoid these problems, the inside surface of the foreline... ...employed to remove unwanted deposition material from the chamber walls and similar areas of the **processing** chamber. Common chamber cleaning techniques include the use of an etching gas, such as fluorine ... ...deposition material from the foreline is more difficult because the foreline is downstream from the **processing** chamber. In a fixed time period, most points within the **processing** chamber come in contact with more of the etchant fluorine atoms than do points within ... ...a need for an apparatus for efficiently and thoroughly cleaning the foreline in a semiconductor **processing** system and a method of doing the same.

One approach that has been employed to... ...for cleaning a foreline is desirable.

Another issue of concern in CVD and other substrate **processing apparatus** relates to the types of gases and byproducts exhausted from the **processing** chamber through the foreline. For example, because dissociation of gas within the cleaning plasma is... ...containing gases employed in the semiconductor industry as cleaning etchant gases are referred to as **perfluorocompounds** or "PFC's" for short. Some of the more commonly used PFC's include CF4... ...of government and other regulations. Accordingly, it is important to reduce PFC emissions from semiconductor **processing equipment** such as CVD reaction chambers.

The DE 43 19 118 A1 relates to a method... ...containing compounds.

It is an object of the invention to provide an apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber which is improved with respect to the above problems.

This object is achieved by... ...matter and other residual material from building up in an exhaust line of a substrate **processing** chamber and/or reducing PFC emissions from such a chamber. Different embodiments of the present... ...an embodiment optimized for both particle and PFC emissions reduction for use with certain substrate **processing** operations.

The present invention achieves these goals while being process transparent. That is, in preferred embodiments, operation of the present invention takes no additional **processing** time to either prevent particulate matter from building up within the foreline or reduce PFC ... ...particulate matter that would otherwise collect in the vacuum line when exhausted from a substrate **processing** chamber (e.g., during a CVD step) are trapped in the gas passageway. The apparatus... ...other embodiments, the present invention is designed and optimized to reduce PFC emissions from semiconductor **processing equipment**. One embodiment of such an apparatus includes a vessel chamber that defines a fluid conduit... ...and collection system reduces particle build up within an exhaust line connected to a substrate **processing** chamber and the collected particles and residue provides the PFC oxidizing agent. The particle trapping... ...of the present invention can be used in conjunction with a variety of different semiconductor **processing** devices. One suitable device, a chemical vapor deposition machine, is shown in Fig. 1 which... ...12) can be controllably moved between a lower loading/off-loading position and an upper **processing** position 14 which is closely adjacent manifold 11.

When susceptor 12 and the wafer are in **processing** position 14, they are surrounded by a baffle plate 17 having a plurality of spaced holes 23 which exhaust into an annular vacuum manifold 24. During **processing**, gas inlet to manifold 11 is uniformly distributed radially across the surface of the wafer... ...heating for effecting deposition.

A motor, not shown, raises and lowers susceptor 12 between a **processing** position 14 and a lower, wafer-loading position. The motor, gas supply valves (not shown... ...temperature, RF power levels, susceptor position, and other parameters of a particular process.

During semiconductor **processing** operations such as chemical vapor deposition processes carried out by CVD reactor 10, a variety... ...the apparatus of the present invention is positioned downstream from the exhaust gas source -- the **processing** chamber. The apparatus may either connect to or replace a portion of the vacuum foreline... ...power supplies or may both be driven from the main RF power supply connected to **processing** chamber 10.

Such a two-DPA configuration may also be used to employ two DPAs... ...the inventors are aware, silane-based silicon nitride CVD deposition operations are among the substrate **processing** operations that generate the most particles. Other substrate **processing** operations may also generate particle build-up and residue, however. For example, similar residues are...Fig. 3(a)). DPA 40 is connected to the foreline (or directly connected to the **processing** chamber) through coupling mechanisms 64 and 66 (Fig 3(a)). For example, in one embodiment... ...at coupling mechanism 66. Gases and particulate matter exhausted into the foreline from the substrate **processing** chamber pass into DPA 40 through inlet 50 and exit from outlet 52.

A removable... ...effluent gas stream, e.g., particles generated during a substrate deposition or other type of **processing** step. Each particle collection area 62 is a "U"-shaped segment of the gas passageway... ...can be a separate RF power supply that drives only DPA 40. Additionally, assuming multiple **processing** chambers are present in a clean room, the multiple DPAs connected to the chambers may... ...through connection 68.

In standard operation, DC power is supplied to electrode 56 during substrate **processing** steps, such as a CVD step, to enhance the particle trapping capabilities of DPA 40... ...effective trapping mechanism. Such DC voltage can be applied at all times during chamber operation (**processing** and clean steps) or may be stopped during the chamber clean operation when DPA 40 is activated.

In one substrate **processing** operation, where silicon nitride was deposited from a process gas of SiH4)), N2)) and NH3... ...DC field within DPA 40 provided an optimal electrostatic collector for use with this substrate **processing** operation.

In Fig. 5, line 110 represents the total accumulation of negatively-charged particles collected... ...with the particles and residue trapped within the DPA from one or more previous substrate **processing** steps. Preferably, the application of RF energy to form this plasma is discontinued during times... ...supplied to the DPA during a clean sequence only, during a deposition or other substrate **processing** step only, or it could be continuously supplied during both deposition and clean cycles. In an embodiment where the etchant gas is supplied to the DPA during a substrate **processing** step, RF energy is applied to electrode 56 during the substrate **processing** step to form a plasma and further etch deposited material from within the DPA.

The... ...upstream of the DPA to control chamber pressure and one downstream to control DPA pressure **independent** of the pressure within the **processing** chamber.

Without a throttle valve downstream of the DPA, the pressure within the DPA is... ...about 106,6 Pa - 333,1 Pa (0.8-2.5 torr) in some PECVD **processing** apparatuses operated at about 600 Pa - 800 Pa (4.5-6 torr). With a throttle... ...53 sends a signal to processor 34 to turn OFF both the DPA and substrate **processing** chamber 10. In a preferred embodiment, switch 53 is a half-atmosphere switch that initiates... ...fourth side (the backside) of the DPA is placed directly against part of the substrate **processing** chamber. The degree of cooling provided by fins 69 depends on thesize of the fins... ...of the DPA, experiments were performed to determine the composition of residue deposited in the **processing** chamber by a silicon nitride deposition step followed by a fluorine clean step. The composition...

residue samples were collected: powder collected in the foreline approximately 0.5 m downstream the **processing** chamber immediately after an Si3))N4)) deposition step as described above (sample A); powder collected... ...in the first meters of the foreline. This white powder presents a high F content, **accounting** for the transformation of Six))Ny))Hz)) into (NH4)))2))SiF6)) (ammonium hexafluoro silicate, which... ...405b.

Electrodes 402 and 404 define a gas passageway 405 through which gases exhausted from **processing** chamber 15 pass. Electrode 402 is grounded while RF and DC power is applied to... ...outlet 403.

If appropriate, a DC filter 412 can be positioned between DPA 40 and **processing** chamber 15 so that the voltage applied to the DPA to help trap electrically charged matter in the effluent gas stream does not interfere with substrate **processing** operations occurring within the chamber.

A diagram showing the electrical circuit that includes electrodes 402... ...452 to provide an electrostatic collector as previously described during a deposition or other substrate **processing** operation. DC power to electrode 452 is switched OFF (by a switch not shown) and... ...66,7 Pa (100-500 millitorr) (base foreline pressure) up to the pressure within the **processing** chamber 533,2 Pa - 2666 Pa (4-20 torr) in the case of a PECVD... ...240. In Fig. 18, PR2) 240 includes a tube 250 through which exhaust gases from **processing** chamber 15 flow as they pass through PR2) 240. Tube 250 is a cylindrical tube... ...serves at least two purposes. First, it acts as a Faraday cage and shields CVD **processing apparatus** 10 and other equipment from the radiation generated by coil 252. Second, if ceramic tube... ...electrodes 320 and 322 define a gas passageway (fluid conduit) through which gases exhausted from **processing** chamber 15 pass. Module 310 includes both electrostatic and mechanical trapping mechanisms to ensure that...many other equivalent or alternative devices for and methods of reducing PFC emissions from a **processing** chamber according to the present invention will be apparent to those skilled in the art...

Claims: ...A1

1. An apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, said apparatus comprising:

a first electrode comprising an electrode wall enclosing an inner chamber...: ...collect electrically charged particulate matter on the opposing electrode surfaces.

2. An apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, said apparatus comprising

> a vessel chamber, defining a fluid conduit having an inlet port and an outlet port, said vessel chamber communicatively coupled to said <B>processing</B> chamber at said inlet port and said vessel chamber comprising:

(i) a plurality of first... ...for supplying a voltage to said plurality of first electrodes to form a plasma from **perfluorocompound** gases present in said fluid conduit.

3. The apparatus of claim 1or 2 comprising:

> a...

Claims: ...B1

1. An apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, the apparatus comprising:

a fluid conduit (54; 270; 324; 405; 435; 456; 470) communicating... ...vessel chamber defined by the fluid conduit (270), the vessel chamber communicatively coupled to the **processing** chamber at the inlet port and the vessel chamber comprising:

(i) a plurality of first... ...for supplying a voltage to the plurality of first electrodes to form a plasma from **perfluorocompound** gases present in the fluid conduit.

3. The apparatus of claim 1 or 2, wherein...

DIALOG(R)File 348: EUROPEAN PATENTS

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01283694

Method and apparatus for treating perfluorocompound gas
Verfahren und Vorrichtung zur Behandlung von Perfluorverbindungen enthaltenden Gasen
Procede et dispositif pour le traitement de gaz contenant des composants perfluoros
Method and apparatus for **treating perfluorocompound** gas

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Abstract ...A1

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Available Text	Language	Update	Word Count

CLAIMS A	(English)	200122	714
SPEC A	(English)	200122	4466
CLAIMS B	(English)	200708	626
CLAIMS B	(German)	200708	630
CLAIMS B	(French)	200708	766
SPEC B	(English)	200708	4571
Total Word Count (Document A) 5181			
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Total Word Count (All Documents) 11774			

Specification: ...A1

BACKGROUND OF THE INVENTION

The present invention relates to a method for **treating perfluorocompound** (PFC) gas, and an apparatus thereof.

PFC a general term of CF4)), C2))F6)), C3... ...atmosphere; has been disclosed in JP-A-11-70322 (1999).

During study of the PFC **treating** method, wherein the PFC gas is decomposed; the decomposed gas is washed; and the washed... ...exhaust pipe with the washed PFC decomposed gas in the method or the apparatus for **treating** the PFC decomposed gas.

The gist of the present invention is in exhausting the PFC... ...disclosed in JP-A-11-216455 (1999), but the prior art is not aimed at **treating** the PFC decomposed gas. JP-A-8-318122 (1996) and JP-A-57-197023 have... ...after water washing apparatus in the process, but the prior art are not aimed at **treating** the corrosive mist of PFC decomposed gas, neither.

SUMMARY OF THE INVENTION

When SF6)) or... ...accompanying drawings, wherein,

FIG. 1 is a schematic illustration indicating an example of the PFC **treating apparatus** relating to the present invention installed with a semiconductor etching oven,

FIG. 2A is a... ...19. The waste water 20 can be made harmless by a ready-made waste water **treating** facility in the semiconductor factory. The mist separated by the cyclone can also be stored... ...Material for the exhaust gas blower is similar with the exhaust gas pipe.

(Embodiment 1)

Treatment of SF6)) was performed by the PFC **treatment apparatus** indicated in FIG. 1 except the etching oven 99, the packed tower 101, and the... ...discharge electrode and the dust collecting electrode.

As the result of performing the SF6)) decomposition **treatment** similarly as the embodiment 1 using 8 kV, the SO3)) concentration at the outlet of... ...back stream of the decomposed gas washing tower, can

be suppressed in the PFC gas **treatment**.

Specification: ...BACKGROUND OF THE INVENTION

The present invention relates to a method and an apparatus or **treating perfluorocompound** (PFC) gas,

PFC is a general term for CF4)), C2))F6)), C3))F8)), SF6)), NF3... ...atmosphere, has been disclosed in JP-A-11-70322 (1999).

During study of the PFC **treating** method, wherein the PFC gas is decomposed, the decomposed gas is washed, and the washed... ...exhaust pipes by the washed decomposed PFC gas in the method or the apparatus for **treating** the PFC decomposed gas.

The gist of the present invention is separating mist containing PFC... ...disclosed in JP-A-11-216455 (1999), but this prior art does not relate to **treating** decomposed PFC gas. JP-A-8-318122 (1996) and JP-A-57-197023 disclose methods... ...is used after water washing of the gas, but this prior does not relate to **treating** a corrosive mist of decomposed PFC gas, neither.

US 5 955 037 discloses a method and an apparatus for the **treatment** of gaseous effluents such as waste gases from semiconductor manufacturing operations. The system comprises a... ...comprise a scrubber, an oxidation unit such as an electrothermal oxidizer, and a post-oxidation **treatment** unit, such as a wet or dry scrubber. It is mentioned in the description of this document (column 11, 2nd paragraph) that the constituent **treatment** units may include an oxidizer which can be, inter alia, a catalytic oxidizer. The system... ...from the gas released from gas washing.

The above problem is solved according to the **independent** claims. The dependent claims relate to preferred embodiments of the invention.

SUMMARY OF THE INVENTION ... ...OF THE DRAWINGS

FIG. 1 is a schematic illustration indicating an example of the PFC **treating apparatus** relating to the present invention installed with a semiconductor etching oven,

FIG. 2A is a... ...collector collects the mist from a gas flowing in a strong electric field by electrostatic **charging**, and the mist is collected at an opposite electrode portion. A schematic cross section of... ...19. The waste water 20 can be made harmless by a ready-made waste water **treating** facility in the semiconductor factory. The mist separated by the cyclone can also be stored... ...the exhaust gas blower is similar to that of the exhaust gas pipe.

Embodiment 1

Treatment of SF6)) was performed by the PFC **treatment apparatus** illustrated in FIG. 1 except the etching oven 99, the packed tower 101, and the... ...discharge electrode and the dust collecting electrode.

As the result of performing the SF6)) decomposition **treatment** similarly as in embodiment 1 using 8 kV, the SO3)) concentration at the outlet of... ...are provided downstream of the decomposed gas washing tower, can be suppressed in PFC gas **treatment**.

Claims: ...A1

1. A method of **treating perfluorocompound** (PFC) gas comprising the steps of:

decomposing the PFC,

washing the gas generated by the decomposition of PFC, and

exhausting the washed ,... ...washed gas is performed after removing mist from said washed gas.

2. A method of **treating perfluorocompound** (PFC) gas comprising the steps of:

decomposing the PFC,

washing the gas generated by the decomposition of PFC, and

exhausting the washed... ...after removing mist containing PFC decomposition product from said washed gas.

3. A method of **treating perfluorocompound** (PFC) gas comprising the steps of:

decomposing the PFC by any one of method selected from the group consisting of hydrolysis, oxidation... ...of removing mist containing PFC decomposition product from said washed gas.

4. A method of **treating perfluorocompound** (PFC) gas comprising the steps of:

decomposing the PFC by diluting said PFC with nitrogen, and contacting the diluted gas with a... ...of removing mist containing PFC decomposition product from said washed gas.

5. An apparatus for **treating perfluorocompound** (PFC) gas comprising:

a gas washing tower (13), wherein at least one of water or... ...which separates mist from said gas washed at said washing tower.

6. An apparatus for **treating perfluorocompound** (PFC) comprising:

a decomposition apparatus (1) for **decomposing** PFC to a gas containing hydrogen fluoride, and

a decomposed gas washing apparatus (13) for... ...said gas which is washed at said decomposed gas washing apparatus.

7. An apparatus for **treating perfluorocompound** (PFC) gas comprising:

a decomposition tower (1) for **decomposing** PFC by any one of method selected from the group consisting of hydrolysis, oxidation decomposition... ...washed at said gas washing tower (13) reaches said blower (16).

8. An apparatus for **treating perfluorocompound** (PFC) gas comprising:

a catalyst reaction tower (1) packed with PFC decomposition catalyst (8), wherein... ...a location in the upper stage than said exhaust blower (16).

9. An apparatus for **treating perfluorocompound** (PFC) gas as claimed in claim 5, wherein

said mist separating apparatus is a cyclone... ...mist contained in the gas is separated by a centrifugal force.

10. An apparatus for **treating perfluorocompound** (PFC) gas as claimed in claim 5, wherein

said mist separating apparatus is a filter...

Claims: ...B1

1. Method of **treating perfluorocompound** (PFC) gas comprising perfluorinated compounds,

comprising(A) <B>decomposing</B> the PFC gas by hydrolysis, oxidation decomposition, combustion or thermal decomposition with a PFC decomposition... ...30) is used comprising a liquid outlet (36) for discharging mist liquid.

6. Apparatus for **treating perfluorocompound** (PFC) gas comprising perfluorinated compounds,

comprising- a PFC decomposition apparatus (1) for <B>decomposing</B> PFC gas comprising a PFC decomposition catalyst for <B>decomposing</B> the PFC gas by hydrolysis, oxidation decomposition combustion or thermal decomposition,

- a gas washing apparatus...

DIALOG(R)File 348: EUROPEAN PATENTS

6/3K/4
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Apparatus for vacuum line cleaning in substrate processing equipment
Reinigungsvorrichtung fur Vakuumleitung in einer Substrat-Bearbeitungsvorrichtung
Appareil de nettoyage d'un tube a vide dans un dispositif de traitement de substrate
Apparatus for vacuum line cleaning in substrate **processing equipment**

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CLAIMS A	(English)	199819	367
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Specification:

The present invention relates generally to the field of semiconductor **processing equipment** and more specifically to a method and apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and to method and apparatus for reducing **perfluorocompound** (PFC) gas emissions from a **processing** chamber.

During chemical vapor deposition (CVD) **processing**, deposition gases are released inside a **processing** chamber to form a thin film layer on the surface of a substrate being processed. Unwanted deposition on areas such as the walls of the **processing** chamber also occurs during such CVD processes. Because the residence time in the chamber of... ...life of the pump. Also, the solid matter may backwash from the foreline into the **processing** chamber and contaminate **processing** steps adversely effecting wafer yield.

To avoid these problems, the inside surface of the foreline... ...employed to remove unwanted deposition material from the chamber walls and similar areas of the **processing** chamber. Common chamber cleaning techniques include the use of an etching gas, such as fluorine ... ...deposition material from the foreline is more difficult because the foreline is downstream from the **processing** chamber. In a fixed time period, most points within the **processing** chamber come in contact with more of the etchant fluorine atoms than do points within ... ...a need for an apparatus for efficiently and thoroughly cleaning the foreline in a semiconductor **processing** system and a method of doing the same.

One approach that has been employed to... ...for cleaning a foreline is desirable.

Another issue of concern in CVD and other substrate **processing apparatus** relates to the types of gases and byproducts exhausted from the **processing** chamber through the foreline. For example, because dissociation of gas within the cleaning plasma is...containing gases employed in the semiconductor industry as cleaning etchant gases are referred to as **perfluorocompounds** or "PFC's" for short. Some of the more commonly used PFC's include CF4... ...of government and other regulations. Accordingly, it is important to reduce PFC emissions from semiconductor **processing equipment** such as CVD reaction chambers.

The present invention solves the above problems of the prior... ...matter and other residual material from building up in an exhaust line of a substrate **processing** chamber and/or reducing PFC emissions from such a chamber. Different embodiments of the present... ...an embodiment optimized for both particle and PFC emissions reduction for use with certain substrate **processing** operations.

The present invention achieves these goals while being process transparent. That is, in preferred embodiments, operation of the present invention takes no additional **processing** time to either prevent particulate matter from building up within the foreline or reduce PFC ... ...particulate matter that would otherwise collect in the vacuum line when exhausted from a substrate **processing** chamber (e.g., during a CVD step) are trapped in the gas passageway. The apparatus... ...other embodiments, the present invention is designed and optimized to reduce PFC emissions from semiconductor **processing**

equipment. One embodiment of such an apparatus includes a vessel chamber that defines a fluid conduit... ...and collection system reduces particle build up within an exhaust line connected to a substrate **processing** chamber and the collected particles and residue provides the PFC oxidizing agent. The particle trapping...during an experiment designed to test one embodiment of the present invention.

I. Exemplary Semiconductor **Processing** Chamber

The apparatus of the present invention can be used in conjunction with a variety of different semiconductor **processing** devices. One suitable device, a chemical vapor deposition machine, is shown in Fig. 1 which... ...12) can be controllably moved between a lower loading/off-loading position and an upper **processing** position 14 which is closely adjacent manifold 11.

When susceptor 12 and the wafer are in **processing** position 14, they are surrounded by a baffle plate 17 having a plurality of spaced holes 23 which exhaust into an annular vacuum manifold 24. During **processing**, gas inlet to manifold 11 is uniformly distributed radially across the surface of the wafer... ...heating for effecting deposition.

A motor, not shown, raises and lowers susceptor 12 between a **processing** position 14 and a lower, wafer-loading position. The motor, gas supply valves (not shown... ...used with thermal CVD devices, plasma etching devices, physical vapor deposition devices and other substrate **processing** devices. The apparatus of the present invention and the method for preventing deposition build-up within a vacuum line is not limited to any specific semiconductor **processing apparatus** or to any specific deposition or etching process or method.

II. Exemplary Uses of the Present Invention

During semiconductor **processing** operations such as chemical vapor deposition processes carried out by CVD reactor 10, a variety... ...the apparatus of the present invention is positioned downstream from the exhaust gas source -- the **processing** chamber. ...power supplies or may both be driven from the main RF power supply connected to **processing** chamber 10.

Such a two-DPA configuration may also be used to employ two DPAs... ...the inventors are aware, silane-based silicon nitride CVD deposition operations are among the substrate **processing** operations that generate the most particles. Other substrate **processing** operations may also generate particle build-up and residue, however. For example, similar residues are...Fig. 4(a)). DPA 40 is connected to the foreline (or directly connected to the **processing** chamber) through coupling mechanisms 64 and 66 (Fig 4(a)). For example, in one embodiment... ...at coupling mechanism 66. Gases and particulate matter exhausted into the foreline from the substrate **processing** chamber pass into DPA 40 through inlet 50 and exit from outlet 52.

A removable...effluent gas stream, e.g., particles generated during a substrate deposition or other type of **processing** step. Each particle collection area 62 is a "U"-shaped segment of the gas passageway... ...can be a separate RF power supply that drives only DPA 40. Additionally, assuming multiple **processing** chambers are present in a clean room, the multiple DPAs connected to the chambers may...through connection 68.

In standard operation, DC power is supplied to electrode 56 during substrate **processing** steps, such as a CVD step, to enhance the particle trapping capabilities of DPA 40... ...effective trapping mechanism. Such DC voltage can be applied at all times during chamber operation (**processing** and clean steps) or may be stopped during the chamber clean operation when DPA 40 is activated.

In one substrate **processing** operation, where silicon nitride was deposited from a process gas of SiH4)), N2)) and NH3... ...DC field within DPA 40 provided an optimal electrostatic collector for use with this substrate **processing** operation.

In Fig. 6, line 110 represents the total accumulation of negatively-charged particles collected...with the particles and residue trapped within the DPA from one or more previous substrate **processing** steps. Preferably, the application of RF energy to form this plasma is discontinued during times... ...supplied to the DPA during a clean sequence only, during a deposition or other substrate **processing** step only, or it could be continuously supplied during both deposition and clean cycles. In an embodiment where the etchant gas is supplied to the DPA during a substrate **processing** step, RF energy is applied to electrode 56 during the substrate **processing** step to form a plasma and further etch deposited material from within the DPA.

The...upstream of the DPA to control chamber pressure and one downstream to control DPA pressure **independent** of the pressure within the **processing** chamber.

Without a throttle valve downstream of the DPA, the pressure within the DPA is... ...the pressure of the foreline (between about 0.8-2.5 torr in some PECVD **processing** apparatuses operated at about 4.5-6 torr). With a throttle valve downstream from the... ...53 sends a signal to processor 34 to turn OFF both the DPA and substrate **processing** chamber 10. In a preferred embodiment, switch 53 is a half-atmosphere switch that initiates...fourth side (the backside) of the DPA is placed directly against part of the substrate **processing** chamber. The degree of cooling provided by fins 69 depends on the size of the... ...of the DPA, experiments were performed to determine the composition of residue deposited in the **processing** chamber by a silicon nitride deposition step followed by a fluorine clean step. The composition... ...residue samples were collected: powder collected in the foreline approximately 0.5 m downstream the **processing** chamber immediately after an Si3))N4)) deposition step as described above (sample A); powder collected...in the first meters of the foreline. This white powder presents a high F content, **accounting** for the transformation of Six))Ny))Hz)) into (NH4)))2))SiF6)) (ammonium hexafluoro silicate, which...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994), which is hereby incorporated by reference.

The helical... ...coil. In Fig. 11, DPA 40 includes a tube 150 through which exhaust gases from **processing** chamber 15 flow as they pass through the DPA. Tube 150 is a cylindrical tube...are able to collect and trap 99.9% of all particulate matter exhausted from the **processing** chamber making length a less important factor. Because the length of the coil should be... ...described that DPA 40 is preferably turned ON and OFF during specific periods of a **processing** procedure, the DPA may also be configured as a passive device. As a passive device...405b.

Electrodes 402 and 404 define a gas passageway 405 through which gases exhausted from **processing** chamber 15 pass. Electrode 402 is grounded while RF ...outlet 403.

If appropriate, a DC filter 412 can be positioned between DPA 40 and **processing** chamber 15 so that the voltage applied to the DPA to help trap electrically charged matter in the effluent gas stream does not interfere with substrate **processing** operations occurring within the chamber.

A diagram showing the electrical circuit that includes electrodes 402...452 to provide an electrostatic collector as previously described during a deposition or other substrate **processing** operation. DC power to electrode 452 is switched OFF (by a switch not shown) and... ...135 seconds and the DPA was driven at 200 Watts. CF4)) was introduced into the **processing** chamber at a rate of 1500 sccm and mixed with

N2))O introduced into the...which the DPA was driven was increased to 500 Watts. CF4)) was introduced into the **processing** chamber at a rate of 2000 sccm and mixed with N2))O introduced into the... ...driven was increased to 500 Watts. The rate at which CF4)) was introduced into the **processing** chamber was increased to 2500 sccm and mixed with N2))O introduced into the chamber... ...chamber 15 and to any process where a PFC gas is a byproduct of the **processing** operation performed in chamber 15. Additionally, the present invention may be used to reduce emission...less expensive to operation than higher RF frequencies such as 13.56 MHz. Assuming multiple **processing** chambers are present in a clean room, the multiple PR2)s connected to the chambers... ...filters, however, may be able to convert substantially all the PFC gases exhausted from the **processing** chamber into less harmful gases making length and volume less important factors.

A number of... ...240. In Fig. 21, PR2) 240 includes a tube 250 through which exhaust gases from **processing** chamber 15 flow as they pass through PR2) 240. Tube 250 is a cylindrical tube...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994), which is hereby incorporated by reference. The helical... ...serves at least two purposes. First, it acts as a Faraday cage and shields CVD **processing** **apparatus** 10 and other equipment from the radiation generated by coil 252. Second, if ceramic tube...can range from 100-500 millitorr (base foreline pressure) up to the pressure within the **processing** chamber (4-20 torr in the case of a PECVD process and up to 700...electrodes 320 and 322 define a gas passageway (fluid conduit) through which gases exhausted from **processing** chamber 15 pass. Module 310 includes both electrostatic and mechanical trapping mechanisms to ensure that...many other equivalent or alternative devices for and methods of reducing PFC emissions from a **processing** chamber according to the present invention will be apparent to those skilled in the art...

Specification: ...to a method and apparatus for minimizing deposition in an exhaust line of a substrate **processing** chamber, and in particular to a method and apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and/or to a method and apparatus for reducing **perfluorocompound** (PFC) gas emissions from a **processing** chamber.

During chemical vapor deposition (CVD) **processing**, deposition gases are released inside a **processing** chamber to form a thin film layer on the surface of a substrate being processed. Unwanted deposition on areas such as the walls of the **processing** chamber also occurs during such CVD processes. Because the residence time in the chamber of... ...life of the pump. Also, the solid matter may backwash from the foreline into the **processing** chamber and contaminate **processing** steps adversely affecting wafer yield.

To avoid these problems, the inside surface of the foreline... ...employed to remove unwanted deposition material from the chamber walls and similar areas of the **processing** chamber. Common chamber cleaning techniques include the use of an etching gas, such as fluorine ... ...deposition material from the foreline is more difficult because the foreline is downstream from the **processing** chamber. In a fixed time period, most points within the **processing** chamber come in contact with more of the etchant fluorine atoms than do points within ... ...a need for an apparatus for efficiently and thoroughly cleaning the foreline in a semiconductor **processing** system and a method of doing the same.

From the EP 0 289 858, a... ...formed of a double-wall cylinder and having an inlet conduit connected to a vacuum **processing** chamber and an outlet conduit connected to at least one vacuum pump is provided. A...apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber.

The present invention solves the above problems of the prior art by providing a... ...matter and other residual material from building up in an exhaust line of a substrate **processing** chamber.

The present invention achieves these goals while being process transparent. That is, in preferred embodiments, operation of the present invention takes no additional **processing** time to either prevent particulate matter from building up within the foreline or reduce PFC... ...of the present invention can be used in conjunction with a variety of different semiconductor **processing** devices. One suitable device, a chemical vapor deposition machine, ...15) can be controllably moved between a lower loading/off-loading position and an upper **processing** position 11 which is closely adjacent manifold 11.

When susceptor 15 and the wafer are in **processing** position 11, they are surrounded by a baffle plate 17 having a plurality of spaced holes 23 which exhaust into an annular vacuum manifold 24. During **processing**, gas inlet to manifold 11 is uniformly distributed radially across the surface of the wafer... ...heating for effecting deposition.

A motor, not shown, raises and lowers susceptor 15 between a **processing** position 11 and a lower, wafer-loading position. The motor, gas supply valves (not shown... ...used with thermal CVD devices, plasma etching devices, physical vapor deposition devices and other substrate **processing** devices. The apparatus of the present invention and the method for preventing deposition build-up within a vacuum line is not limited to any specific semiconductor **processing apparatus** or to any specific deposition or etching process or method.

During semiconductor **processing** operations such as chemical vapor deposition processes carried out by CVD reactor 10, a variety... ...the apparatus of the present invention is positioned downstream from the exhaust gas source -- the **processing** chamber. The apparatus may either connect to or replace a portion of the vacuum foreline connected to **processing** chamber 10.

Such a two-DPA configuration may also be used to employ two DPAs... ...the inventors are aware, silane-based silicon nitride CVD deposition operations are among the substrate **processing** operations that generate the most particles. Other substrate **processing** operations may also generate particle build-up and residue, however. For example, similar residues are...Fig. 4(a)). DPA 40 is connected to the foreline (or directly connected to the **processing** chamber) through coupling mechanisms 64 and 66 (Fig 4(a)). For example, in one embodiment... ...at coupling mechanism 66. Gases and particulate matter exhausted into the foreline from the substrate **processing** chamber pass into DPA 40 through inlet 50 and exit from outlet 52.

A removable...effluent gas stream, e.g., particles generated during a substrate deposition or other type of **processing** step. Each particle collection area 62 is a "U"-shaped segment of the gas passageway... ...can be a separate RF power supply that drives only DPA 40. Additionally, assuming multiple **processing** chambers are present in a clean room, the multiple DPAs connected to the chambers may...through connection 68.

In standard operation, DC power is supplied to electrode 56 during substrate **processing** steps, such as a CVD step, to enhance the particle trapping capabilities of DPA 40... ...effective trapping mechanism. Such DC voltage can be applied at all times during chamber operation (**processing** and clean steps) or may be stopped during the chamber clean operation when DPA 40 is activated.

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In Fig. 6, line 110 represents the total accumulation of negatively charged particles collected...with the particles and residue trapped within the DPA from one or more previous substrate **processing** steps.

Preferably, the application of RF energy to form this plasma is discontinued during times... ...supplied to the DPA during a clean sequence only, during a deposition or other substrate **processing** step only, or it could be continuously supplied during both deposition and clean cycles. In an embodiment where the etchant gas is supplied to the DPA during a substrate **processing** step, RF energy is applied to electrode 56 during the substrate **processing** step to form a plasma and further etch deposited material from within the DPA.

The...upstream of the DPA to control chamber pressure and one downstream to control DPA pressure **independent** of the pressure within the **processing** chamber.

Without a throttle valve downstream of the DPA, the pressure within the DPA is... ...106.6 Pa to 333.3Pa (0.8 to 2.5 torr) in some PECVD **processing** apparatuses operated at about 600 Pa to 800 Pa (4.5 to 6 torr). With... ...53 sends a signal to processor 34 to turn OFF both the DPA and substrate **processing** chamber 10. In a preferred embodiment, switch 53 is a half-atmosphere switch that initiates... ...fourth side (the backside) of the DPA is placed directly against part of the substrate **processing** chamber. The degree of cooling provided by fins 69 depends on the size of the...of the DPA, experiments were performed to determine the composition of residue deposited in the **processing** chamber by a silicon nitride deposition step followed by a fluorine clean step. The composition... ...residue samples were collected: powder collected in the foreline approximately 0.5 m downstream the **processing** chamber immediately after an Si3))N4)) deposition step as described above (sample A); powder collected... ...in the first meters of the foreline. This white powder presents a high F content, **accounting** for the transformation of Six))Ny))Hz)) into (NH4)))2))SiF6)) (ammonium hexafluoro silicate, which...

Claims:

1. An apparatus for collecting particles exhausted from a substrate **processing** chamber, the apparatus comprising:

> first and second structures each having opposing surfaces defining a fluid... ...An apparatus as claimed in claim 3 connected in an exhaust line of a substrate <B>processing</B> chamber to receive etchant gases exhausted through said exhaust line from a substrate <B>processing</B> chamber during a cleaning operation of said substrate chamber.

5. An apparatus as claimed in claim 3 connected in an exhaust line of a substrate **processing** chamber, wherein at least a portion of said etchant gases are introduced into said exhaust line upstream of the apparatus and downstream from said substrate **processing** chamber.

6. An apparatus as claimed in claim 3, wherein at least a portion of...

Claims: ...B1

1. Apparatus to be connected in an exhaust line of a substrate **processing** chamber for minimizing deposition in an exhaust line of the substrate **processing** chamber comprising

> - a fluid conduit (54) having an inlet (50), an outlet (52) and a... ...each U-turn.

7. Apparatus to be connected in an exhaust line of a substrate **processing** chamber for minimizing deposition in an exhaust line of the substrate **processing** chamber comprising

- gas passageway (435) having an inlet (434), an outlet (436) and a collection... ...electrode surfaces.

9. Method of for minimizing deposition in an exhaust line of a substrate **processing** chamber comprising:

- connecting an apparatus according to any of the preceding claims in an exhaust line of a substrate <B>processing</B> chamber, and

- introducing etchant gases exhausted through the exhaust line from the substrate <B>processing</B> chamber during a cleaning operation of the substrate <B>processing</B> chamber.

10. The method of claim 9, wherein etchant gases are introduced into the exhaust line upstream of the apparatus and downstream from the substrate **processing** chamber.

11. The method of claim 9, wherein etchant gases are introduced directly into the...

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Method and apparatus for minimizing deposition in an exhaust line
Verfahren und Vorrichtung zur Verminderung von Ablagerungen in einer Abgasleitung
Procede et appareil pour minimaliser les depots dans une ligne d'echappement

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	Country	Number	Kind	Date	
Patent	EP	839929	A1	19980506	(Basic)
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Application	EP	97118103		19971016	
Priorities	US	741241		19961030	

Designated States:
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Legal Status

Type	Pub. Date	Kind	Text

Language
Publication: English
Procedural: English
Application: English

Fulltext Availability

Available Text	Language	Update	Word Count
CLAIMS A	(English)	199819	573
SPEC A	(English)	199819	23259
CLAIMS B	(English)	200217	441
CLAIMS B	(German)	200217	398
CLAIMS B	(French)	200217	510
SPEC B	(English)	200217	6101
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Total Word Count (Document B) 7450			

Specification: ...to a method and apparatus for minimizing deposition in an exhaust line of a substrate **processing** chamber, and in particular to a method and apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and/or to a method and apparatus for reducing **perfluorocompound** (PFC) gas emissions from a **processing** chamber.

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It is the object of the invention to provide an... ...apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and in particular for reducing **perfluorocompound** (PFC) gas emissions from the **processing** chamber.

The present invention solves the above problems of the prior art by providing a... ...matter and other residual material from building up in an exhaust line of a substrate **processing** chamber and/or reducing PFC emissions from such a chamber.

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The...upstream of the DPA to control chamber pressure and one downstream to control DPA pressure **independent** of the pressure within the **processing** chamber.

Without a throttle valve downstream of the DPA, the pressure within the DPA is... ...0.8 to 2.5 torr (106.6 Pa to 333.3Pa) in some PECVD **processing** apparatuses operated at about 4.5 to 6 torr(600 Pa to 800 Pa). With... ...53 sends a signal to processor 34 to turn OFF both the DPA and substrate **processing** chamber 10. In a preferred embodiment, switch 53 is a half-atmosphere switch that initiates...fourth side (the backside) of the DPA is placed directly against part of the substrate **processing** chamber. The degree of cooling provided by fins 69 depends on the size of the... ...of the DPA, experiments were performed to determine the composition of residue deposited in the **processing** chamber by a silicon nitride deposition step followed by a fluorine clean step. The composition... ...residue samples were collected: powder collected in the foreline approximately 0.5 m downstream the **processing** chamber immediately after an Si3))N4)) deposition step as described above (sample A); powder collected...in the first meters of the foreline. This white powder presents a high F content, **accounting** for the transformation of Six))Ny))Hz)) into (NH4)))2))SiF6)) (ammonium hexafluoro silicate, which...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994), which is hereby incorporated by reference.

The helical... ...coil. In Fig. 11, DPA 40 includes a tube 150 through which exhaust gases from **processing** chamber 15 flow as they pass through the DPA. Tube 150 is a cylindrical tube...are able to collect and trap 99.9% of all particulate matter exhausted from the **processing** chamber making length a less important factor. Because the length of the coil should be... ...described that DPA 40 is preferably turned ON and OFF during specific periods of a **processing** procedure, the DPA may also be configured as a passive device. As a passive device...405b.

Electrodes 402 and 404 define a gas passageway 405 through which gases exhausted from **processing** chamber 15 pass. Electrode 402 is grounded while RF and DC power is applied to... ...outlet 403.

If appropriate, a DC filter 412 can be positioned between DPA 40 and **processing** chamber 15 so that the voltage applied to the DPA to help trap electrically charged matter in the effluent gas stream does not interfere with substrate **processing** operations occurring within the chamber.

A diagram showing the electrical circuit that includes electrodes 402...452 to provide an electrostatic collector as previously described during a deposition or other substrate **processing** operation. DC power to electrode 452 is switched OFF (by a switch not shown) and... ...135 seconds and the DPA was driven at 200 Watts. CF4)) was introduced into the **processing** chamber at a rate of 1500.sccm and mixed with N2))O introduced into the...which the DPA was driven was increased to 500 Watts. CF4)) was

introduced into the **processing** chamber at a rate of 2000 sccm and mixed with N2))O introduced into the... ...driven was increased to 500 Watts. The rate at which CF4)) was introduced into the **processing** chamber was increased to 2500 sccm and mixed with N2))O introduced into the chamber... ...chamber 15 and to any process where a PFC gas is a byproduct of the **processing** operation performed in chamber 15. Additionally, the present invention may be used to reduce emission...less expensive to operation than higher RF frequencies such as 13.56 MHz. Assuming multiple **processing** chambers are present in a clean room, the multiple PR2)s connected to the chambers... ...filters, however, may be able to convert substantially all the PFC gases exhausted from the **processing** chamber into less harmful gases making length and volume less important factors. A number of...240. In Fig. 21, PR2) 240 includes a tube 250 through which exhaust gases from **processing** chamber 15 flow as they pass through PR2) 240. Tube 250 is a cylindrical tube... ...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994), which is hereby incorporated by reference. The helical... ...serves at least two purposes. First, it acts as a Faraday cage and shields CVD **processing apparatus** 10 and other equipment from the radiation generated by coil 252. Second, if ceramic tube...3 Pa to 66.7 Pa) (base foreline pressure) up to the pressure within the **processing** chamber (4 to 20 torr (533.2 Pa to 2666 Pa) in the case of...electrodes 320 and 322 define a gas passageway (fluid conduit) through which gases exhausted from **processing** chamber 15 pass. Module 310 includes both electrostatic and mechanical trapping mechanisms to ensure that...many other equivalent or alternative devices for and methods of reducing PFC emissions from a **processing** chamber according to the present invention will be apparent to those skilled in the art...

Specification: ...to a method and apparatus for minimizing deposition in an exhaust line of a substrate **processing** chamber, and in particular to a method and apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and/or to a method and apparatus for reducing **perfluorocompound** (PFC) gas emissions from a **processing** chamber.

During chemical vapor deposition (CVD) **processing**, deposition gases are released inside a **processing** chamber to form a thin film layer on the surface of a substrate being processed. Unwanted deposition on areas such as the walls of the **processing** chamber also occurs during such CVD processes. Because the residence time in the chamber of... ...life of the pump. Also, the solid matter may backwash from the foreline into the **processing** chamber and contaminate **processing** steps adversely effecting wafer yield.

To avoid these problems, the inside surface of the foreline... ...employed to remove unwanted deposition material from the chamber walls and similar areas of the **processing** chamber. Common chamber cleaning techniques include the use of an etching gas, such as fluorine ... ...deposition material from the foreline is more difficult because the foreline is downstream from the **processing** chamber. In a fixed time period, most points within the **processing** chamber come in contact with more of the etchant fluorine atoms than do points within ... ...a need for an apparatus for efficiently and thoroughly cleaning the foreline in a semiconductor **processing** system and a method of doing the same.

One approach that has been employed to... ...for cleaning a foreline is desirable.

Another issue of concern in CVD and other substrate **processing apparatus** relates to the types of gases and byproducts exhausted from the **processing** chamber through the foreline. For example, because dissociation ... double-wall cylinder is provided which vessel has an inlet conduit connected to a vacuum **processing** chamber and an outlet conduit connected to at least one vacuum pump. A passage for... ...temperature difference is therebetween.

The CA-A-1 282 732 shows an apparatus for the **treatment** of post-reaction gases wherein residual

products are caused to be deposited out of the... ...December 27, 1995 and October 30, 1996 shows a method and an apparatus for reducing **perfluorocompound** gases from substrate **processing equipment** emissions. With the priority of December 27, 1995, there is disclosed an apparatus comprising a... :..method for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber.

The present invention solves the above problems of the prior art by an apparatus... ...process transparent. That is, in preferred embodiments, operation of the present invention takes no additional **processing** time to either prevent particulate matter from building up within the foreline. Also, in some... ...of the present invention can be used in conjunction with a variety of different semiconductor **processing** devices. One suitable device, a chemical vapor deposition machine, is shown in Fig. I which... ...12) can be controllably moved between a lower loading/off-loading position and an upper **processing** position 14 which is closely adjacent manifold 11.

When susceptor 12 and the wafer are in **processing** position 14, they are surrounded by a baffle plate 17 having a plurality of spaced holes 23 which exhaust into an annular vacuum manifold 24. During **processing**, gas inlet to manifold 11 is uniformly distributed radially across the surface of the wafer... heating for effecting deposition.

A motor, not shown, raises and lowers susceptor 12 between a **processing** position 14 and a lower, wafer-loading position. The motor, gas supply valves (not shown ... ...used with thermal CVD devices, plasma etching devices, physical vapor deposition devices and other substrate **processing** devices. The apparatus of the present invention and the method for preventing deposition build-up within a vacuum line is not limited to any specific semiconductor **processing apparatus** or to any specific deposition or etching process or method.

During semiconductor **processing** operations such as chemical vapor deposition processes carried out by CVD reactor 10, a variety... ...the apparatus of the present invention is positioned downstream from the exhaust gas source -- the **processing** chamber. The apparatus may either connect to or replace a portion of the vacuum foreline... ...power supplies or may both be driven from the main RF power supply connected to **processing** chamber 10.

Such a two-DPA configuration may also be used to employ two DPAs...the inventors are aware, silane-based silicon nitride CVD deposition operations are among the substrate **processing** operations that generate the most particles. Other substrate **processing** operations may also generate particle build-up and residue, however. For example, similar residues are...can be a separate RF power supply that drives only DPA 40. Additionally, assuming multiple **processing** chambers are present in a clean room, the multiple DPAs connected to the chambers may... ...with cost considerations.

In standard operation, DC power is supplied to electrode 56 during substrate **processing** steps, such as a CVD step, to enhance the particle trapping capabilities of DPA 40... ...effective trapping mechanism. Such DC voltage can be applied at all times during chamber operation (**processing** and clean steps) or may be stopped during the chamber clean operation when DPA 40 is activated.

In one substrate **processing** operation, where silicon nitride was deposited from a process gas of SiH4)), N2)) and NH3... ...DC field within DPA 40 provided an optimal electrostatic collector for use with this substrate **processing** operation.

In Fig. 5, line 110 represents the total accumulation of negatively-charged particles collected...with the particles and residue trapped within the DPA from one or more previous substrate **processing** steps.

Preferably, the application of RF energy to form this plasma is discontinued during times...452 to provide an electrostatic collector as previously described during a deposition or other substrate **processing** operation. DC power to electrode 452 is switched OFF (by a switch not shown) and...

Claims:

1. Method for minimizing deposition in an exhaust line of a substrate **processing** chamber, characterized by mechanically and/or electrostatically and/or thermophoretically trapping particular matter contained in gases exhausted from the substrate **processing** chamber, and by bringing an etchant gas into contact with the trapped particular matter to... ...into said apparatus.

5. Apparatus for minimizing deposition in an exhaust line of a substrate **processing** chamber, characterized by first and second members defining a fluid conduit which includes a collection... ...and further characterized by positioning the fluid conduit next to and downstream of the substrate **processing** chamber.

6. Apparatus for minimizing deposition in an exhaust line of a substrate **processing** chamber, characterized by first and second members defining a fluid conduit, which includes a collection... ...gases into the exhaust line upstream of the fluid conduit and downstream from the substrate **processing** chamber or preferably directly into the fluid conduit.

10. Apparatus according to claim 6, characterized... ...and wherein said voltage is applied to said first and second electrodes during a substrate **processing** operation to collect said electrically charged particulate matter and said switch couples said electrodes to...

Claims: ...B1

1. Apparatus for minimizing deposition in an exhaust line of a substrate **processing** chamber comprising

- a gas passage way (456, 470) arranged between an inlet (458, 474) and... ...452, 480).

7. A method for minimizing deposition in an exhaust line of a substrate **processing** chamber, wherein

- exhaust gases from the substrate <B>processing</B> chamber are pumped through a gas passage way (456, 470) defined by electrodes (452, 454...

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Method and apparatus for reducing perfluorocompound gases from substrate processing equipment emissions
Verfahren und Vorrichtung zur Reduzierung von Perfluorverbindungen enthaltenden Abgasen aus Substratbearbeitungsvorrichtungen.

Procede et appareil pour reduire des gaz d'echappement contenant des composes perfluores provenant d'un dispositif de traitement de substrat
Method and apparatus for reducing **perfluorocompound** gases from substrate **processing equipment** emissions

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Abstract ...A2

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Language

Publication: English
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Fulltext Availability

Available Text	Language	Update	Word Count
CLAIMS A	(English)	EPAB97	926
SPEC A	(English)	EPAB97	23182
CLAIMS B	(English)	200237	954
CLAIMS B	(German)	200237	926
CLAIMS B	(French)	200237	1106
SPEC B	(English)	200237	22853
Total Word Count (Document A) 24112			
Total Word Count (Document B) 25839			
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Specification:

The present invention relates generally to the field of semiconductor **processing equipment** and more specifically to a method and apparatus for eliminating contaminants and residues from inside a vacuum exhaust line connected to a **processing** chamber and to a method and apparatus for reducing **perfluorocompound** (PFC) gas emissions from a **processing** chamber.

During chemical vapor deposition (CVD) **processing**, deposition gases are released inside a **processing** chamber to form a thin film layer on the surface of a substrate being processed. Unwanted deposition on areas such as the walls of the **processing** chamber also occurs during such CVD processes. Because the residence time in the chamber of... ...life of the pump. Also, the solid matter may backwash from the foreline into the **processing** chamber and contaminate **processing** steps adversely effecting wafer yield.

To avoid these problems, the inside surface of the foreline... ...employed to remove unwanted deposition material from the chamber walls and similar areas of the **processing** chamber. Common chamber cleaning techniques include the use of an etching gas, such as fluorine ... ...deposition material from the foreline is more difficult because the foreline is downstream from the **processing** chamber. In a fixed time period, most points within the **processing** chamber come in contact with more of the etchant fluorine atoms than do points within ... ...a need for an apparatus for efficiently and thoroughly cleaning

the foreline in a semiconductor **processing** system and a method of doing the same.

One approach that has been employed to... ...for cleaning a foreline is desirable.

Another issue of concern in CVD and other substrate **processing apparatus** relates to the types of gases and byproducts exhausted from the **processing** chamber through the foreline. For example, because dissociation of gas within the cleaning plasma is...containing gases employed in the semiconductor industry as cleaning etchant gases are referred to as **perfluorocompounds** or "PFC's" for short. Some of the more commonly used PFC's include CF4... ...of government and other regulations. Accordingly, it is important to reduce PFC emissions from semiconductor **processing equipment** such as CVD reaction chambers.

The present invention solves the above problems of the prior... ...matter and other residual material from building up in an exhaust line of a substrate **processing** chamber and/or reducing PFC emissions from such a chamber. Different embodiments of the present... ...an embodiment optimized for both particle and PFC emissions reduction for use with certain substrate **processing** operations.

The present invention achieves these goals while being process transparent. That is, in preferred embodiments, operation of the present invention takes no additional **processing** time to either prevent particulate matter from building up within the foreline or reduce PFC ... ...particulate matter that would otherwise collect in the vacuum line when exhausted from a substrate **processing** chamber (e.g., during a CVD step) are trapped in the gas passageway. The apparatus... ...other embodiments, the present invention is designed and optimized to reduce PFC emissions from semiconductor **processing equipment**. One embodiment of such an apparatus includes a vessel chamber that defines a fluid conduit... ...and collection system reduces particle build up within an exhaust line connected to a substrate **processing** chamber and the collected particles and residue provides the PFC oxidizing agent. The particle trapping...during an experiment designed to test one embodiment of the present invention.

I. Exemplary Semiconductor **Processing** Chamber

The apparatus of the present invention can be used in conjunction with a variety of different semiconductor **processing** devices. One suitable device, a chemical vapor deposition machine, is shown in Fig. 1 which... ...12) can be controllably moved between a lower loading/off-loading position and an upper **processing** position 14 which is closely adjacent manifold 11.

When susceptor 12 and the wafer are in **processing** position 14, they are surrounded by a baffle plate 17 having a plurality of spaced holes 23 which exhaust into an annular vacuum manifold 24. During **processing**, gas inlet to manifold 11 is uniformly distributed radially across the surface of the wafer... ...heating for effecting deposition.

A motor, not shown, raises and lowers susceptor 12 between a **processing** position 14 and a lower, wafer-loading position. The motor, gas supply valves (not shown... ...used with thermal CVD devices, plasma etching devices, physical vapor deposition devices and other substrate **processing** devices. The apparatus of the present invention and the method for preventing deposition build-up within a vacuum line is not limited to any specific semiconductor **processing apparatus** or to any specific deposition or etching process or method.

II. Exemplary Uses of the Present Invention

During semiconductor **processing** operations such as chemical vapor deposition processes carried out

by CVD reactor 10, a variety... ...the apparatus of the present invention is positioned downstream from the exhaust gas source -- the **processing** chamber. ...power supplies or may both be driven from the main RF power supply connected to **processing** chamber 10.

Such a two-DPA configuration may also be used to employ two DPAs... ...the inventors are aware, silane-based silicon nitride CVD deposition operations are among the substrate **processing** operations that generate the most particles. Other substrate **processing** operations may also generate particle build-up and residue, however. For example, similar residues are...Fig. 4(a)). DPA 40 is connected to the foreline (or directly connected to the **processing** chamber) through coupling mechanisms 64 and 66 (Fig 4(a)). For example, in one embodiment... ...at coupling mechanism 66. Gases and particulate matter exhausted into the foreline from the substrate **processing** chamber pass into DPA 40 through inlet 50 and exit from outlet 52.

A removable...effluent gas stream, e.g., particles generated during a substrate deposition or other type of **processing** step. Each particle collection area 62 is a "U"-shaped segment of the gas passageway... ...can be a separate RF power supply that drives only DPA 40. Additionally, assuming multiple **processing** chambers are present in a clean room, the multiple DPAs connected to the chambers may...through connection 68.

In standard operation, DC power is supplied to electrode 56 during substrate **processing** steps, such as a CVD step, to enhance the particle trapping capabilities of DPA 40... ...effective trapping mechanism. Such DC voltage can be applied at all times during chamber operation (**processing** and clean steps) or may be stopped during the chamber clean operation when DPA 40 is activated.

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The...control chamber pressure and one downstream to control DPA pressureindependent of the pressure within the **processing** chamber.

Without a throttle valve downstream of the DPA, the pressure within the DPA is... ...the pressure of the foreline (between about 0.8-2.5 torr in some PECVD **processing** apparatuses operated at about 4.5-6 torr). With a throttle valve downstream from the... ...53 sends a signal to processor 34 to turn OFF both the DPA and substrate **processing** chamber 10. In a preferred embodiment, switch 53 is a half-atmosphere switch that initiates...fourth side (the backside) of the DPA is placed directly against part of the substrate **processing** chamber. The degree of cooling provided by fins 69 depends on the size of the... ...of the DPA, experiments were performed to determine the composition of residue deposited in the **processing** chamber by a silicon nitride deposition step followed by a fluorine clean step. The composition... ...residue samples were collected: powder collected in the foreline approximately 0.5 m downstream the **processing** chamber immediately after an Si3))N4)) deposition step as described above

(sample A); powder collected...in the first meters of the foreline. This white powder presents a high F content, **accounting** for the transformation of Six))Ny))Hz)) into (NH4)))2))SiF6)) (ammonium hexafluoro silicate, which...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**, " pp. 404-410 John Wiley & Sons (1994), which is hereby incorporated by reference.

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If appropriate, a DC filter 412 can be positioned between DPA 40 and **processing** chamber 15 so that the voltage applied to the DPA to help trap electrically charged matter in the effluent gas stream does not interfere with substrate **processing** operations occurring within the chamber.

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Specification: ...B1

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The DE 43 19 118 A1 relates to a method... ...particulate matter and other material from building up in an exhaust line of a substrate **processing** chamber and reducing PFC emissions from such a chamber. Different embodiments of the present invention... ...an embodiment optimized for both particle and PFC emissions reduction for use with certain substrate **processing** operations.

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In Fig. 6, line 110 represents the total accumulation of negatively-charged particles collected... ...with the particles and residue trapped within the DPA from one or more previous substrate **processing** steps. Preferably, the application of RF energy to form this plasma is discontinued during times... supplied to the DPA during a clean sequence only, during a deposition or other substrate **processing** step only, or it could be continuously supplied during both deposition and clean cycles. In an embodiment where the etchant gas is supplied to the DPA during a substrate **processing** step, RF energy is applied to electrode 56 during the substrate **processing** step to form a plasma and further etch deposited material from within the DPA.

The...upstream of the DPA to control chamber pressure and one downstream to control DPA pressure **independent** of the pressure within the **processing** chamber.

Without a throttle valve downstream of the DPA, the pressure within the DPA is... ...about 106,6 Pa-333,3 Pa (0.8-2.5 torr) in some PECVD **processing** apparatuses operated at about 600 Pa-800 Pa (4.5-6 torr)). With a throttle... ...53 sends a signal to processor 34 to turn OFF both the DPA and substrate **processing** chamber 10. In a preferred embodiment, switch 53 is a half-atmosphere switch that initiates... ...fourth side (the backside) of the DPA is placed directly against part of the substrate **processing** chamber. The degree of cooling provided by fins 69 depends on the size of the... ...of the DPA, experiments were performed to determine the composition of residue deposited in the **processing** chamber by a silicon nitride deposition step followed by a fluorine clean step. The composition... residue samples were collected: powder collected in the foreline approximately 0.5 m downstream the **processing** chamber immediately after an Si3))N4)) deposition step as described above (sample A); powder collected... ...in the first meters of the foreline. This white powder presents a high F content, **accounting** for the transformation of Six))Ny))Hz)) into (NH4)))2))SiF6)) (ammonium hexafluoro silicate, which...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994).

The helical resonator coil can be made out...coil. In Fig. 11, DPA 40 includes a tube 150 through which exhaust gases from **processing** chamber 15 flow as they pass through the DPA. Tube 150 is a cylindrical tube... ...are able to collect and trap 99.9% of all particulate matter exhausted from the **processing** chamber making length a less important factor. Because the length of the coil should be... ...described that DPA 40 is preferably turned ON and OFF during specific periods of a **processing** procedure, the DPA may also be configured as a passive device. As a passive device...405b.

Electrodes 402 and 404 define a gas passageway 405 through which gases exhausted from **processing** chamber 15 pass. Electrode 402 is grounded while RF and DC power is applied to... ...outlet 403.

If appropriate, a DC filter 412 can be positioned between DPA 40 and **processing** chamber 15 so that the voltage applied to the DPA to help trap electrically charged matter in the effluent gas stream does not interfere with substrate **processing** operations occurring within the chamber.

A diagram showing the electrical circuit that includes electrodes 402...452 to provide an electrostatic collector as previously described during a deposition or other substrate **processing** operation. DC power to electrode 452 is switched OFF (by a switch not shown) and...135 seconds and the DPA was driven at 200 Watts. CF4)) was introduced into the **processing** chamber at a rate of 1500 seem and mixed with N2))O introduced into the ... ...which the DPA was driven was increased to 500 Watts. CF4)) was introduced into the **processing** chamber at a rate of 2000 sccm and mixed with N2))O introduced into the... ...driven was increased to 500 Watts. The rate at which CF4)) was introduced into the **processing** chamber was increased to 2500 sccm ...chamber 15 and to any process where a PFC gas is a byproduct of the **processing** operation performed in chamber 15. Additionally, the present invention may be used to reduce emission... less expensive to operation than higher RF frequencies such as 13.56 MHz. Assuming multiple **processing** chambers are present in a clean room, the multiple PR2)s connected to the chambers... ...filters, however, may be able to convert substantially all the PFC gases exhausted from the **processing** chamber into less harmful gases making length and volume less important factors.

A number of... ...240. In Fig. 21, PR2) 240 includes a tube 250 through which exhaust gases from **processing** chamber 15 flow as they pass through PR2) 240. Tube 250 is a cylindrical tube...such as Michael A. Lieberman and Allan J. Lichtenberg, "Principles of Plasma Discharges and Materials **Processing**," pp. 404-410 John Wiley & Sons (1994). The helical resonator coil can be made out...

...serves at least two purposes. First, it acts as a Faraday cage and shields CVD **processing apparatus** 10 and other equipment from the radiation generated by coil 252. Second, if ceramic tube... 66,7 Pa (100-500 millitorr) (base foreline pressure) up to the pressure within the **processing** chamber 533,2 Pa-2666 Pa (4-20 torr) in the case of a PECVD...electrodes 320 and 322 define a gas passageway (fluid conduit) through which gases exhausted from **processing** chamber 15 pass. Module 310 includes both electrostatic and mechanical trapping mechanisms to ensure that...many other equivalent or alternative devices for and methods of reducing PFC emissions from a **processing** chamber according to the present invention will be apparent to those skilled in the art...

Claims:

1. An apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, said apparatus comprising:

a vessel chamber, defining a fluid conduit having an inlet port... ...containing residue and particulate matter on the opposing electrode surfaces.

14. An apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, said apparatus comprising:

a vessel chamber, defining a fluid conduit having an inlet port... ...a plasma from PFC gases present in said fluid conduit.

15. An apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, said apparatus comprising:

a vessel chamber, defining a fluid conduit having an inlet port... ...gases present in said fluid conduit into a plasma state.

16. An apparatus for reducing **perfluorocompound** emissions from a **processing** chamber, said apparatus comprising:

a first electrode comprising an electrode wall enclosing an inner chamber... ...collect electrically charged particulate matter on the opposing electrode surfaces.

17. An apparatus for reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, said apparatus comprising:

(a) a vessel chamber, defining a fluid conduit having an inlet port and an oulet port, said vessel chamber communicatively coupled to said **processing** chamber at said inlet port and said vessel chamber comprising:

(i) a plurality of first... ...for supplying a voltage to said plurality of first electrodes to form a plasma from **perfluorocompound** gases present in said fluid conduit.

Claims: ...B1

1. An apparatus reducing **perfluorocompound** (PFC) emissions from a **processing** chamber, said apparatus comprising:

a vessel chamber (254), defining a fluid (250) conduit having an... ...apparatus as claimed in claim 1, wherein said vessel chamber is communicatively coupled to said **processing** chamber at said inlet port and said vessel chamber said apparatus comprising:

(i) a plurality... ...an interior surface defining a portion of said fluid conduit.

16. A method of reducing **perfluorocompound** (PFC) emissions form a substrate **processing** chamber, said method comprising:

performing an first operation within said substrate **processing** chamber in which reactive species from a plasma formed from one or more PFC gases are present within said substrate **processing** chamber;

during the first operation, exhausting gases from said substrate **processing** chamber into a plasma chamber fluidly coupled to an exhaust outlet of said substrate **processing** chamber and supplying a PFC oxidizing agent into said plasma chamber by collecting silicon-containing residue or particles in said plasma chamber after being exhausted from said substrate **processing** chamber during the first operation performed prior to a chamber cleaning operation, wherein said plasma chamber is not configured to process semiconductor substrates;

thereafter, performing second operation within the **processing** chamber in which reactive species from a plasma formed from one or more PFC gases are present within said substrate **processing** chamber;

during the second operation, exhausting gases from the substrate **processing** chamber into the plasma chamber; and

forming a plasma of the gases exhausted

? **ds**

```
Set     Items   Description
S1        236   (PERFLUORIDE? OR PERFLUOROCOMPOUND?) AND (TREATMENT OR TRE-
              ATING OR PROCESSING OR DECOMPOSTION OR DECOMPOSING )
S2     197048   (TREATMENT OR TREATING OR PROCESSING OR DECOMPOSTION OR DE-
              COMPOSING ) (W) (EQUIPMENT OR APPARATUS)
S3         17   S1 AND S2 AND (COST OR BILLING)
S4         31   S1 AND S2
S5          9   (INDEPENDENT OR (THIRD ADJ PARTY)) AND S4
S6          6   S5 AND (BILL??? OR CHARGING OR FEE OR ACCOUNT???)
```

? **s s5 not s6**

```
             9  S5
             6  S6
      S7     3  S5 NOT S6
```

? **t s7/3,k/1-3**

7/3K/1
01382417

SELF-COOLING GAS DELIVERY APPARATUS UNDER HIGH VACUUM FOR HIGH DENSITY PLASMA APPLICATIONS
APPAREIL AUTOREFRIGERANT DE DISTRIBUTION DE GAZ SOUS VIDE POUSSE POUR APPLICATIONS AU PLASMA HAUTE DENSITE

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GB; GD; GE; GH; GM; HR; HU; ID; IL; IN;
IS; JP; KE; KG; KM; KN; KP; KR; KZ; LC;
LK; LR; LS; LT; LU; LV; LY; MA; MD; MG;
MK; MN; MW; MX; MZ; NA; NG; NI; NO; NZ;
OM; PG; PH; PL; PT; RO; RU; SC; SD; SE;
SG; SK; SL; SM; SY; TJ; TM; TN; TR; TT;

TZ; UA; UG; US; UZ; VC; VN; YU; ZA; ZM;
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[EP] AT; BE; BG; CH; CY; CZ; DE; DK; EE; ES;
FI; FR; GB; GR; HU; IE; IS; IT; LT; LU;
LV; MC; NL; PL; PT; RO; SE; SI; SK; TR;

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[AP] BW; GH; GM; KE; LS; MW; MZ; NA; SD; SL;
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English Abstract:

A gas distributor (400) for use in a semiconductor **processing** chamberl 17 is provided. The gas distributor comprises a gas inlet (420 a gas outlet...

Detailed Description:

...been applied to a self-cooling gas delivery apparatus used with a high density plasma **processing** chamber. The method and apparatus can be applied to other applications as well such as... ...for a self-cooling gas delivery apparatus for use in HDP-CVD and other semiconductor **processing apparatus**.

SUMMARY OF THE INVENTION
[00051 This present invention relates generally to semiconductor manufacturing equipment.

More... ...to a I 0 self-cooling gas delivery apparatus used with a high density plasma **processing** chamber. The method and apparatus can be applied to other applications as well such as... ...embodiment of the present invention, a gas distributor is provided for use in a semiconductor **processing** chamber. The gas distributor includes a gas inlet and a gas outlet. The gas distributor... ...embodiment is an O-ring.

[00071 In another embodiment of the present invention, a substrate **processing** system includes a **processing** chamber having an interior upper surface that includes a centered circular opening, a substrate support member disposed in the **processing** chamber, and a gas distributor that extends through the circular opening in the upper surface... ...conventional gas delivery baffle.

[00091 FIG. 2 is a simplified schematic illustration of a semiconductor **processing** chamber according to an embodiment of the present invention.

[00101 FIG. 3 is graph of... ...been applied to a self-cooling gas delivery apparatus used with a high density plasma **processing** chamber. The

3
[0018] FIG. I is a simplified schematic illustration of a conventional gas... ...the gas deflecting surface.

100191 FIG. 2 is a simplified schematic illustration of a semiconductor **processing** chamber according to an embodiment of the present invention. The semiconductor **processing** chamber illustrated in FIG. 2 is one embodiment of a high density plasma chemical vapor... ...the present invention can be implemented in combination with a variety of HDP-CVD substrate **processing** chambers including chambers in which a plasma is formed by the application of RF energy... ...as aluminum oxide or aluminum nitride. Dome 114 defines an upper boundary of a plasma **processing** region 1 16. Plasma **processing** region 1 1 6 is bounded on
4
the bottom by the upper surface of... ...the substrate from the robot blade at an upper loading position 157 to a lower **processing** position 156 in which the substrate is placed on a substrate receiving portion 1 19... ...that can be used to secure the substrate to substrate support II 8 during substrate **processing**.

[00241 Vacuum system 170 includes throttle body 125, which houses twin-blade throttle valve 126... ...1 A, whereas side coil 130 is powered by side SRF generatot 13 IB, allowing **independent** power levels and frequencies of operation for each coil. In a specific embodiment, the top... ...distributor 145 and top vent 146. Top gas distributor 145 and top vent 146 allow **independent** control of top and side flows of the gases, which improves film uniformity and allows... ...gas source in sources 134(a)..134(n) (e.g., molecular fluorine, nitrogen trifluoride, other **perfluorocompound** or equivalents alone or in combination with another gas such as argon) in reactor cavity... ...parameters of a particular process.

fOO331 In some embodiments of the present invention, the semiconductor **processing** chamber is operated at reduced pressure. For example, HDP-CVD systems generally operate at lower... ...the gas pressure in the gas delivery system generally exceeds the gas pressure in the **processing** chamber.

[00341 FIG. 3 is graph of thermal contact resistance v. gap gas pressure for... ...109. The O-ring provides for a seal between the gas delivery system and the **processing** chamber as gas is delivered through gas inlet 1 12. In some HDPCVD systems, the... ...to the gas delivery baffle is about 5 Torr. In contrast, the pressure inside the **processing** chamber is much lower. Of course, the chamber pressure varies with the application, but in... ...and mounting flange 630. The mounting flange attaches to an upper surface of the semiconductor **processing** chamber. Cooling water is provided to the gas delivery block by cooling water intake port... ...of the present invention, the mounting flange 630 makes contact with the dome of the **processing** chamber, while the gas
distributor is located inside the chamber,
[00421 FIG. 8 is a... ...one of skill in the art, depending on the operating parameters selected for the semiconductor **processing** chamber.

[00471 Although embodiments in accordance with the present invention have utilized gas distributors mounted... :..and a distal portion, the proximal portion connected to a chamber wall of a semiconductor **processing** chamber and the distal portion oriented inwardly away from the chamber wall into an interior of the semiconductor **processing** chamber. As illustrated in FIG. 9, a proximal end 920 of the gas nozzle is... ...make 1 5 contact with the lateral seat and the chamber wall of the semiconductor **processing** chamber.

In a specific embodiment, the sealing member is an O-ring. In some embodiments...

Claims:

I 1. A gas distributor for use in a semiconductor **processing** chamber, the gas distributor comprising:a gas inlet;a gas outlet;a stem section having... ...The gas distributor of claim I wherein the gas distributor is alumina.
7 A substrate **processing** system, the system comprising:
a <B>processing</B> chamber having an interior upper surface that includes a centeredcircular opening;a substrate support member disposed in the <B>processing</B> chamber;a gas distributor that extends through the circular opening in the upper surface of... ...of the gas distributor and a second pressure exists in an interior portion of the <B>processing</B> chamber.
12 The apparatus of claim I I wherein the first pressure is greater than... ...the second pressure is about 5 mTorr.

14 The apparatus of claim 7 wherein the **processing** chamber is a high density plasma chamber.
15 The apparatus of claim 7 wherein the... ...consisting of aluminum and fluoropolymer resin.

18 A gas nozzle for use in a semiconductor **processing** chamber, the nozzle comprising:a proximal portion and a distal portion, the proximal portion connected to a chamber wall of the semiconductor <B>processing</B> chamber, the distal portion oriented inwardly away from the chamber wall into an interior of the semiconductor <B>processing</B> chamber;a proximal end configured to be coupled with a gas supply;a stem section... ...disposed tomake contact with the lateral seat and the chamber wall of the semiconductor <B>processing</B> chamber. I 20. The gas nozzle of claim 18 wherein the sealing member is an...

7/3K/2
01168169

METHOD AND APPARATUS FOR TREATING EXHAUST GAS
PROCEDE ET APPAREIL DE TRAITEMENT D'UN GAZ D'ECHAPPEMENT
METHOD AND APPARATUS FOR **TREATING** EXHAUST GAS

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GB; GD; GE; GH; GM; HR; HU; ID; IL; IN;
IS; JP; KE; KG; KP; KR; KZ; LC; LK; LR;
LS; LT; LU; LV; MA; MD; MG; MK; MN; MW;
MX; MZ; NA; NI; NO; NZ; OM; PG; PH; PL;
PT; RO; RU; SC; SD; SE; SG; SK; SL; SY;
TJ; TM; TN; TR; TT; TZ; UA; UG; US; UZ;
VC; VN; YU; ZA; ZM; ZW;

[EP] AT; BE; BG; CH; CY; CZ; DE; DK; EE; ES;
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PL; PT; RO; SE; SI; SK; TR;

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English Abstract:

The present invention relates to a method and apparatus for **treating** an exhaust gas containing a fluorine compound. A method according to the present invention includes...

Detailed Description:

DESCRIPTION
METHOD AND APPARATUS FOR **TREATING** EXHAUST GAS
Technical Field
The present invention relates to a method and apparatus for **treating** an exhaust gas, and more particularly to a method and apparatus for efficiently detoxifying an... ...or a chemical vapor deposition (CVD) process, fluorine compounds such as hydrofluorocarbon (e.g.,, CHF3) **orperfluorocompound** (e.g., CF4. C2F6f C3F8f C4F8f C5F8r C4F6,r SF6,F and NF3) have been... ...also to decompose a gas which causes the global warming.

In a conventional method of **treating** a harmful gas (SiF4f F2. COF2. C5F8,, C4F6. or NH3) included in an exhaust gas... ...to be replaced with a new one periodically, resulting in increased running cost.

A wet **treatment apparatus** (scrubbing process) has been used to scrub an exhaust gas for removing a water-soluble... ...a method of removing PFC from an exhaust gas with various types of catalysts for **decomposing** PFC. However, if the catalyst is deteriorated, then harmful components such as Co. C,5F8... ...atmosphere immediately after deterioration of the catalyst. There has also been proposed a method of **treating** PFC by combustion. However, NOx or CO may be produced as a by-product gas... ...process is required to manage the operation. There has also been proposed a method of **decomposing** PFC by a heating oxidative decomposition.

However, in order to decompose PFC (e.g., CF4... ...oxidative decomposition without free 02 gas. Further, there has also been proposed a method of **decomposing** PFC with a plasma in the presence of water (H@O) . However, when PFC is... ...thermal NOx is also produced.

Therefore, it is necessary to provide a separate exhaust gas **treatment apparatus** for **treating** the harmful gas and the thermal Nox.

The Japanese patent No. 3217034 discloses a method... ...However, there exist various types of fluorine compounds
such as hydrofluorocarbon (e.g., CHF3) and
perfluorocompound (e.g.., CF4. C2F6f C3F8f C4F8, C,5F8, C4F6f
SF6, and NF3) - When such fluorine ... ...being heated. Consequently, there arises
a problem in that a heating section of a gas **treatment** tank
is corroded by an acid gas such as hydrofluoric acid.

Disclosure of Invention
The... ...is therefore an object of the present
invention to provide a method and apparatus for **treating**
an exhaust gas which does not produce an acid gas such as
hydrofluoric acid at a heating section of a gas **treatment**
tank, and can thus prevent the heating section of the gas
treatment tank from being corroded by the acid gas.

According to one aspect of the present invention,
there is provided a method of **treating** an exhaust gas
containing a fluorine compound, the method comprising.

heating the exhaust gas in... ...to the exhaust gas.

In a preferred aspect of the present invention, a
method of **treating** an exhaust gas further comprises: before
the heatingf removing at least one of a powdery... ...from
the exhaust gas.

In a preferred aspect of the present invention, a
method of **treating** an exhaust gas further comprises: after
the fluorine compound is decomposed or oxidized, removing
an... ...removed.

According to another aspect of the present invention.,
there is provided a method of **treating** an exhaust gas
containing a fluorine compound, the method comprising.

heating the exhaust gas in... ...to the exhaust gas.

In a preferred aspect of the present invention, a
method of **treating** an exhaust gas further comprises: be ore
the heating, removing at least one of a... ...from
the exhaust gas.

In a preferred aspect of the present invention, a
method of **treating** an exhaust gas further comprises: after
the fluorine compound is decomposed or oxidized, removing
an... ...gas.

According to another aspect of the present invention,,
there is provided an apparatus for **treating** an exhaust gas
containing a fluorine compound, the apparatus comprising.

a heating section for heating... ...of the heating section.

In a preferred aspect of the present invention, an apparatus for **treating** an exhaust gas further comprises.

a catalytic reactor disposed downstream of the H20 adding section for **decomposing** the fluorine compound by catalytic reaction.

It is preferable that the heating wire is wound... ...catalyst to be accelerated.

In a preferred aspect of the present invention, an apparatus for **treating** an exhaust gas further comprises.

a water heating pipe disposed at the heating section; wherein... ...the water heating pipe.

In a preferred aspect of the present invention, an apparatus for **treating** an exhaust gas further comprises.

a water heating pipe disposed outside of the heating section... ...external heater as desired.

In a preferred aspect of the present invention, an apparatus for **treating** an exhaust gas further comprises.

an air ejector for maintaining a pressure of the exhaust... ...gas.

Brief Description of Drawings
FIG. 1 is a block diagram showing an exhaust gas **treatment apparatus** according to a first embodiment of the present invention;
FIG. 2A is a view showing an example of a gas **treatment** tank;
FIG. 2B is a schematic enlarged view showing a heating wire incorporated in the gas **treatment** tank shown in FIG.

2A;
FIG. 3 is a block diagram showing an exhaust gas **treatment apparatus** according to a second embodiment of the present invention;
FIG. 4A through FIG. 4D are... ...an example of a water (H20) supply or a H2 supply incorporated in the gas **treatment** tank; and
FIG. 5 is a block diagram showing an exhaust gas **treatment apparatus** according to a third embodiment of the present invention.

Best Mode for Carrying Out the Invention
An exhaust gas **treatment apparatus** according to embodiments of the present invention will be described below with ref erence to... ...throughout drawings and will not be described below repetitively.

FIG. 1 shows an exhaust gas **treatment apparatus** according to a first embodiment of the present invention.

The exhaust gas **treatment apparatus** comprises a pre-**treatment** section for removing powdery components, water-soluble components, or hydrolytic components from an exhaust gas containing fluorine compounds, a heating oxidative **decomposing** section for performing heating oxidative decomposition of the pre-treated exhaust gas, and a post-**treatment** section for post-**treating** an acid gas such as HF which has been produced by the heating oxidative decomposition.

In this embodiment, a fan scrubber I serves as the pre-**treatment** section. An exhaust gas to be treated passes through the fan scrubber 1 and then... ...separator 2. The exhaust gas is introduced from the mist separator 2 into a gas **treatment** tank 3 through an exhaust gas introduction pipe 11. The fan scrubber 1 and the... ...components are removed from the exhaust gas.

Instead of the fan scrubber 1, the pre-**treatment** section may comprise a water spray tower, a gas passage stirring tank, or an adsorption... ...a circulating pump 15 which compresses the water.

Devices to be used as the pre-**treatment** section can properly be selected according to components in the exhaust gas to be treated... ...an adsorbent uses no water,, it is suitable for a case where no waste water **treatment equipment** is provided in the system.

If the exhaust gas contains materials which should specially be... ...that would be difficult to be removed by another wet scrubbing process.

In the pre-**treatment** section, as described above, powdery components, water-soluble components, or hydrolytic components are removed from... ...gas such as SiF4 or F2 is removed from the exhaust gas in the pre- **treatment** section.

The exhaust gas which has passed through the pre-**treatment** sectionf i.e. the fan scrubber 1f is introduced into the gas **treatment** tank 3 through the exhaust gas introduction pipe 11, and is then heated to be oxidized or decomposed. The heating oxidative decomposition is performed in the gas **treatment** tank 3. An air pipe (i.e., an 02 supply pipe) 5 is connected to the gas **treatment** tank

3 for supplying 02 necessary for the reaction. A water pipe 6 is connected to the gas **treatment** tank 3 for supplying water (e.g. f city water or industrial water) necessary for... ...purifier 7 connected to the water pipe 6, and is then supplied to the gas **treatment** tank 3. Thereafter,, the purified water is vaporized by a water heating pipe and is supplied to an end portion of a heating section of the gas **treatment** tank 3. Alternatively, water required for the reaction may be sprayed with a spray provided in the heating oxidative **decomposing** tank (the gas **treatment** tank 3) without being vaporized by the water heating pipe - In this case, the sprayed water is heated and vaporized in the heating oxidative **decomposing** tank.

FIG. 2A shows an example of a structure of the gas **treatment** tank, and FIG. 2B is a schematic enlarged view showing a heating wire incorporated in the gas **treatment** tank shown in FIG. 2A. The gas **treatment** tank 3 has an electric tube furnace 9 made of ceramics and serving as a... ...of the heating section 30. A water heating pipe 8 is provided in the gas **treatment** tank 3, and is connected to the water pipe 6 which supplies water (H20) The... ...40 shown in FIG. 2A) located just downstream of the heating section of the gas **treatment** tank 3, oxidation of Co and decomposition of PFC having four or more carbon atoms... ...the heating section 30 is surrounded by a heat insulator 20 provided in the gas **treatment** tank 3. In this H20 adding section 40, the following reactions proceed due to addition... ...not added to the exhaust gas in the heating section 30.

Therefore, in the gas **treatment** tank 3, the electric tube furnace 9 and the plate members 10 constituting the heating... ...02-rich air, and pure 02 Peroxide may be used as 02- In this gas **treatment** tank 3, the air pipe 5 is connected to the exhaust gas introduction pipe 11, so that air and the exhaust gas to be treated are introduced into the gas **treatment** tank 3 from the top of the gas **treatment**'tank 3. The aforementioned components in the exhaust gas can be oxidized and decomposed at... ...economically select a fire-resistant element.

which is required to be used in the gas **treatment** tank 3, and hence a manufacturing cost can be lowered. Therefore, in the present embodiment... ...and decomposition are performed at a temperature ranging from 700 to 900'C.

The post-**treatment** section post-treats an acid gas such as HF which is produced in the **decomposing** process of fluorine compounds. In the present embodiment, the post-**treatment** section comprises a spray nozzle 13 serving as an acid gas removal section. The decomposed... ...a water film formed by the spray nozzle 13 which is provided in the gas **treatment** tank 3, and the exhaust gas is then introduced to a mist separator 14 through... ...gas .

produced by the decomposition of PFC in the H20 adding section (i.e. , the **decomposing treatment** section) 4 0 of the gas **treatment** tank 3 is removed from the exhaust gas.

Instead of the spray nozzle 13, the post-**treatment** section may comprise a fan scrubber, a water spray tower, a gas passage stirring tankf... ...the adsorption tank can also achieve the aforementioned effects.

FIG. 3 shows an exhaust gas **treatment apparatus** according to a second embodiment of the present invention.

As shown in FIG. 3f the gas **treatment** tank 3 further comprises a catalytic reactor 4 disposed downstream of the heating section 30. In the gas **treatment** tank 3f the exhaust gas is heated to be oxidized or decomposed in the heating... ...catalytic reactor 4 provided downstream of
the H20 adding section (i.e., the oxidative composition **treatment** section) 40 are the same as the components of the exhaust gas **treatment apparatus** shown in FIG. 1.

The catalytic reactor 4 has a catalyst filled therein for **decomposing** PFC, The exhaust gas is introduced into an upper portion of the catalytic reactor 4... ...the decomposition has been added to the exhaust gas, to be treated, in the gas **treatment** tank 3. and water (H20) has been introduced into the exhaust gas at the end... ...heat oxidative decomposition. Therefore, when the catalytic reactor 4 is incorporated into the exhaust gas **treatment apparatus**, components that do not directly affect human bodies but adversely affect the global warming can... ...02 3CO2 + 8HF
2SF6 + 3H20 + 02 S02 + S03 + 6HF
Next, modifications of the exhaust gas **treatment apparatus** according to the above embodiments of the present invention will be described. FIG. 4A shows a gas **treatment** tank 3 having a water heating pipe 8a which is disposed in the electric tube... ...pipe 8 (see FIG. 2A) which is disposed at the upper portion of the gas **treatment** tank 3 and extends linearly. With this structure, heat exchange is sufficiently performed between the... ...gas at the end portion of the heating section 30.

FIG. 4B shows a gas **treatment** tank 3 having a water heating pipe 8b which is disposed on the outer circumferential... ...is then supplied to the end portion of the heating section 30 in the gas **treatment** tank 3. With this structure, a high-temperature vapor (H20) heated by utilizing the exhaust... ...supplied to the end portion of the heating section 30.

FIG. 4C shows a gas **treatment** tank having a water heating pipe 8c which extends from outside to inside of the gas **treatment** tank 3 and opens at the end portion of the

heating section 30 in the gas **treatment** tank 3,, instead of the water heating pipes 8. 8a and 8b which are disposed... ...and then supplied to the end portion of the heating section 30 in the gas **treatment** tank 3. With this structure, water (H20) is heated to a suitable temperature without being... ...portion of the heating section 30 without passing through the external heater 16, depending on **treatment** conditions.

FIG. 4D shows a gas **treatment** tank having a H2 gas supply pipe 8d instead of the pipes for supplying water... ...pipe 8d opens at the end portion of the heating section 30 in the gas **treatment** tank 3. A H2 gas supplied from the H2 gas supply pipe 8d and an... ...for distilling or purifying city water or industrial water, thereby reducing a cost of the **treatment apparatus** as a whole.

Water (H20) is required for the oxidation of CO and the decomposition of PFC. Water (H20) is introduced into the exhaust gas **treatment** system in a vaporized state. If the water contains Si or Ca, then Si or... ...water such as pure water or distilled water. Accordingly, it is necessary to provide an **independent** pipe only for supplying pure water or distilled water to the apparatus, and also to... ...for providing pipes and the like can be eliminated.

FIG. 5 shows an exhaust gas **treatment apparatus** according to a third embodiment of the present invention.

In this embodiment, an air ejector 16 is provided for maintaining a pressure of an exhaust gas treated by the gas **treatment** tank 3 at a predetermined value. The air ejector 16 serves to discharge the exhaust gas forcibly from the gas **treatment** tank 3 where the exhaust gas passes therethrough,, so that an internal pressure of the gas **treatment** tank 3 can be adjusted. With this structure, the heating oxidative decomposition of the exhaust gas in the gas **treatment** tank 3 can be performed at a suitable pressure.

Further, an analyzer 17 is provided...case where the heating oxidative decomposition is not required.

other components of the exhaust gas **treatment apparatus** according to this embodiment are the same as those of the exhaust gas **treatment apparatus** according to above-mentioned embodiments.

Next, test results of exhaust gas **treatment** with a testing apparatus equivalent to the exhaust gas **treatment apparatus** according to the second embodiment will be described. An N2 gas mixed with various types... ...gas supplied at a flow rate of 120 l/min and introduced into the gas **treatment** tank 3. Air was introduced into the heating

oxidative **decomposing** section of the gas **treatment** tank 3 at a flow rate of 30 1/min for supplying 02 required for oxidation.

Similarly, pure water was introduced into the gas **treatment** tank 3 at a flow rate of 5 ml/min for oxidation and decomposition. Table 1 shows the test results of exhaust gas **treatment**. In table 1. example 1 shows the results of a case where pure water was... ...of a case where pure water was introduced from the top portion of the gas **treatment** tank (i.e., the inlet of the heating section).

Table 1
Gas at the outlet of the
Component Post- **treatment** section
Exam le 1 Comparative
p
example 1
CF4 (PPM) <0.2 <0.2
CHF3... ...small
amount of the gas components had been detected at the outlet of the post-**treatment** section as shown in the example 1 and the comparative example 1. These results showed... ...in the case of supplying the pure water from the top portion of the gas **treatment** tank (i.e., the inlet of the heating section).

Next, there will be described study... ...a HF gas produced by supplying water (H20) from the top portion of the gas **treatment** tank 3 (i.e., the inlet of the heating section) . In order to confirm that... ...a high concentration when pure water is Supplied from the top portion of the gas **treatment** tank 3, a gas-introduction test was carried out with a testing apparatus equivalent to the above exhaust gas **treatment apparatus** under the following conditions.

The electric tube furnace (the heater) 9 was controlled so that... ...supplied at a flow rate of 30 1/min, and then introduced into the gas **treatment** tank 3.

In order to measure an amount of HF produced by adding water (H20... ...shows a case where pure water was introduced from the top portion of the gas **treatment** tank 3 (i.e., the inlet of the heating section), and example 2 shows a... ...pure water was not introduced.

Table 2
Gas at the outlet of the
Component post-**treatment** section
Comparative
example 2 Example 2

C F 4(PPM) 2 7 0 0 3... ...in the case where water
(H20) was added from the top portion of the gas **treatment**
tank 3 (i.e., the inlet of the heating section) , as shown
in comparative example... ...instead of adding water (H20) . The testing apparatus and
the testing conditions such as a **treatment** temperature of
a gas were the same as those of the above tests.

In this... ...supplied at a flow rate of 30 1/min, and then
introduced into the gas **treatment** tank 3.

In order to confirm a **treatment** effect of supplying
a H2 gas,, H2 was supplied from the water heating pipe 8 ... ...this test as example 3.

Table 3
Gas at the outlet of the
component post- **treatment** section
Example 3
CF4 (PPM) <0.2
CHF3 (PPM) <0.2
C4F8 (ppm) <0.2... ...iciently treated by introducing
the H2 gas and it is possible to obtain the same **treatment**
effect as the case of adding water (H20)
The exhaust gas **treatment** method and apparatus
according to the present invention are not limited to the
illustrated examples...

Claims:

1 A method of **treating** an exhaust gas containing a
fluorine compound, said method comprising:heating the exhaust gas in... ...to the exhaust gas to
decompose oroxidize the fluorine compound.
2 A method of **treating** an exhaust gas according to
10 claim 1, wherein the fluorine compound is decomposed or... ...of a catalyst after H20 is addedto the
exhaust gas.
3 A method of **treating** an exhaust gas according to
claim 1 or 2, further comprising:before said heating, removing... ...water-soluble component, and
ahydrolytic component from the exhaust gas.
4 A method of **treating** an exhaust gas according to
any one of claims 1 to 3, further comprising:after... ...produced when the fluorinecompound is
decomposed, from the exhaust gas.
5 A method of **treating** an exhaust gas containing a
fluorine compound, said method comprising:heating the exhaust gas in... ...to the exhaust gas to
decompose oroxidize the fluorine compound.
6 A method of **treating** an exhaust gas according to
claim 5, wherein the fluorine compound is decomposed oroxidized... ...a catalyst after H2 is addedto the
exhaust gas.S
7 A method of **treating** an exhaust gas according to
claim 5 or 6, further comprising:before said heating, removing... ...water-soluble component, and
ahydrolytic component from the exhaust gas.
8 A method of **treating** an exhaust gas according to

any one of claims 5 to 7, further comprising:after... ...when the fluorinecompound is decomposed, from the exhaust gas.
9 An ap-Paratus for **treating** an exhaust gas containing
a fluorine compound, said apparatus comprising:a heating section for heating... ...gasproduced by a reaction between the exhaust gas and H20
10 An apparatus for **treating** an exhaust gas according
to claim 9, wherein said heating section comprises a heatingwire... ...wound thinlyat an outlet-side part of said heating section.
11 An apparatus for **treating** an exhaust gas according
to claim 9, further comprising:a catalytic reactor disposed downstream of said H20adding section for <B>decomposing</B> the fluorine compound bycatalytic reaction.
12 An apparatus for **treating** an exhaust gas according
to claim 9, further comprising:a water heating pipe disposed at... ...water heating pipeand is heated by said water heating pipe.
13 An apparatus for **treating** an exhaust gas according
to claim 9, further comprising:a water heating pipe disposed outside... ...said water heating pipeand is heated by said external heater.
14 An apparatus for **treating** an exhaust gas according
to claim 9, further comprising:an air ejector for maintaining a...

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METHOD AND APPARATUS FOR TREATING EXHAUST GAS
PROCEDE ET APPAREIL DESTINES AU TRAITEMENT DES GAZ D'ECHAPPEMENT
METHOD AND APPARATUS FOR **TREATING** EXHAUST GAS

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English Abstract:

An apparatus for **treating** an exhaust gas has a pre-**treatment** section (1) for removing at least one of a powdery component, a water-soluble component... ...gas containing at least one of a fluorine compound

and CO, and a heating oxidative **decomposing** section (2) for performing heating oxidative decomposition of the at least one of the fluorine compound and CO to detoxify the exhaust gas. The apparatus has a post- **treatment** section (4) for post-**treating** an acid gas such as HF which has been produced by the heating oxidative decomposition.

Detailed Description:

DESCRIPTION
METHOD AND APPARATUS FOR **TREATING** EXHAUST GAS
Technical Field
The present invention relates to a method and apparatus for **treating** an exhaust gas, and more particularly to a method and apparatus for efficiently detoxifying an ...also to decompose a gas which causes the global warming.

In a conventional method of **treating** a harmful gas (SiF4 F F2 f COF2 . C5F., C4F6 I or NH3)included in... ...by an adsorbent such as a synthetic zeolite. However, in this conventional method, Co or **perfluorocompound** (PFC) cannot be removed from the exhaust gas. Further, the adsorbent needs to be ...a method of removing PFC from an exhaust gas with various types of catalysts for **decomposing** PFC. However, if the catalyst is deteriorated, then harmful components such as CO, C5F8 , and... ...atmosphere immediately after deterioration of the catalyst. There has also been proposed a method of **treating** PFC by combustion. However, NOx or CO may be produced as a by-product gas...process is required to manage the operation. There has also been proposed a method of **decomposing** PFC by heating oxidation. However, in order to decompose PFC (e.g. . CF4) that is...without free 02 gas.

However, there has not been proposed a method of heating oxidative **decomposing** PFC with the coexistence of O..

Further, there has also been proposed a method of **decomposing** PFC with a plasma in the presence of water (H20) However, when PFC is decomposed... ...thermal Nox is also produced.

Therefore, it is necessary to provide a separate exhaust gas **treatment apparatus** for **treating** the harmful gas and the thermal NOx.

Disclosure of Invention
...is therefore an object of the present invention to provide a method and apparatus for **treating** an exhaust gas which can treat a fluorine compound and CO simultaneously and efficiently, can... ...According to a first aspect of the present invention, there is provided a method of **treating** an exhaust gas containing at least one of a fluorine compound and CO, the method...900'C.

According to a preferred aspect of the present invention, the method further comprises **decomposing** the exhaust gas by catalytic reaction.

According to a preferred aspect of the present invention... ...According to a second aspect of the present invention, there is provided a method of **treating** an exhaust gas containing at least one of a ...According to a third aspect of the present invention, there is provided an apparatus for **treating** an exhaust gas containing at least one of a fluorine compound and CO, the apparatus comprising: a first **treatment** section for removing at least one of a powdery component, a water soluble component and a hydrolytic component from the exhaust gas; a heating oxidative **decomposing** section for performing heating oxidative decomposition of the at least one of the fluorine compound... ...to detoxify the exhaust gas; an 02 supply for supplying 02 to the heating oxidative **decomposing** section; an H20 supply for supplying H20 to the heating oxidative **decomposing** section; and a second **treatment** section for removing an acid gas in the exhaust gas after the heating oxidative decomposition... ...preferred aspect of the present invention, the apparatus further comprises a catalytic reaction section for **decomposing** the exhaust gas by ...example.

Brief Description of Drawings
FIG. I is a block diagram showing an exhaust gas **treatment apparatus** according to a first embodiment of the present invention;
FIG. 2 is a block diagram showing an exhaust gas **treatment apparatus** according to a second embodiment of the present invention;
FIG. 3 is a block diagram showing an exhaust gas **treatment apparatus** according to a third embodiment of the present invention; and
FIG. 4 is a perspective view showing an exhaust gas **treatment apparatus** shown in FIG. 1, 2 or 3.

Best Mode for Carrying Out the Invention
An exhaust gas **treatment apparatus** according to embodiments of the present invention will be described below with reference to FIGS. 1 through 4.

FIG. I shows an exhaust gas **treatment apparatus** according to a first embodiment of the present invention.

As shown in FIG. 1, the exhaust gas **treatment apparatus** comprises a pre-**treatment** section 1 for removing powdery components, water-soluble components, or hydrolytic components from an exhaust gas containing fluorine

compounds and carbon monoxide (CO), a heating oxidative **decomposing** section 2 for performing heating oxidative decomposition of the pre-treated exhaust gas, and a post-**treatment** section 4 for post-**treating** an acid gas such as HF which has been produced by the heating oxidative decomposition.

The pre-**treatment** section 1 may comprise a water spray tower la for pre-**treatment** by gas-liquid contact, for example. The spray tower la is supplied with service water...removed f rom the exhaust gas. Instead of the water spray tower la, the pre-**treatment** section 1 may comprise a fan scrubber, a gas passage stirring tank, or an adsorption... adsorption tank can also achieve the aforementioned effects.

Devices to be used as the pre-**treatment** section 1 can properly be selected according to components in the exhaust gas to be... ...an adsorbent uses no water, it is suitable for a case where no waste water **treatment equipment** is provided in the system.

If the exhaust gas contains materials which should specially be...be dif f icult to be removed by another wet scrubbing process.

In the pre- **treatment** section 1, as described above, powdery components, water-soluble components, or hydrolytic components are removed...gas in the pretreatment section 1.

The exhaust gas which has passed through the pre **treatment** section 1 is introduced into the heating oxidative **decomposing** section 2 and decomposed therein.

The heating oxidative **decomposing** section 2 has a heating oxidative **decomposing** reactor 2a where the **decomposing** process is performed, an air pipe (O 2 supply pipe) 5 connected to the heating oxidative **decomposing** reactor 2a for supplying 02 necessary for the reaction to the heating oxidative **decomposing** reactor 2a, and a water pipe (H 20 supply pipe) 6 connected to the heating oxidative **decomposing** reactor 2a for supplying water (tap water or industrial water) necessary for the reaction to the heating oxidative **decomposing** reactor 2a. The tap water or the industrial water is purified up to a level... ...is then vaporized by a water vaporizer 8, and is supplied to the heating oxidative **decomposing** reactor 2a.

Alternatively, water required for the reaction may be sprayed with a spray provided in the heating oxidative **decomposing** reactor 2'a without being vaporized by the water vaporizer 8. In this case, the sprayed water is heated and vaporized in the heating oxidative **decomposing** reactor 2a.

The heating oxidative **decomposing** section 2 has an electric tube furnace 9 made of ceramics which is provided around the heating oxidative **decomposing** reactor 2a. The electric tube furnace 9 serves as a heating device for heating the... ...and water (H20) to a temperature ranging from 700 to 9000C. In the heating oxidative **decomposing** reactor 2a, oxidation of CO and decomposition of PFC having four or more carbon atoms...it is possible to economically select a fire-resistant element used in the heating oxidative **decomposing** reactor.

Therefore, in the present embodiment, the oxidation and decomposition are performed at a temperature ranging from 700 to 900'C.

The post-**treatment** section 4 post-treats an acid gas such as HF which is produced in the **decomposing** process of fluorine compounds. In the present embodiment, the post-**treatment** section 4 comprises a water spray tower 4a for post-**treatment**. The water spray tower 4a is supplied with service water or industrial waterr which is... ...water spray 4b. As a result, HF produced by the decomposition in the heating oxidative **decomposing** reactor 2a is removed from the exhaust gas.

Instead of the water spray tower 4a, the post- **treatment** section 4 may comprise a fan scrubber, a gas passage stirring tank, or an adsorption... ...the adsorption tank can also achieve the aforementioned effects.

FIG. 2 shows an exhaust gas **treatment apparatus** according to a second embodiment of the present invention.

As shown in FIG. 2, the exhaust gas **treatment apparatus** comprises a catalytic reaction section 3 for further **decomposing** an exhaust gas by catalytic reaction after the heating oxidative decomposition. The exhaust gas which has passed through the heating oxidative **decomposing** section 2 is successively introduced into a catalytic reactor 3a in the catalytic reaction section... ...structures of the present embodiment are the same as the structures of the exhaust gas **treatment apparatus** shown in FIG. 1.

The catalytic reactor 3a has a catalyst f illed therein for **decomposing** PFC. The exhaust gas is introduced into an upper portion of the catalytic reactor 3a...contribute to the decomposition have been introduced into the system at the upstream heating oxidative **decomposing** reactor 2a. The catalyst comprises a catalyst for fluorine compounds, such as 7 alumina or... ...that are unlikely to be discomposed and has not been decomposed by the heat oxidative **decomposing** reactor 2a can be decomposed

by the catalytic reaction section 3. Therefore, when the catalytic reaction section 3 is incorporated into the exhaust gas **treatment apparatus**, components that do not directly affect human bodies but adversely affect the global warming or...02 3CO2 + 8HF
2SF6 + 3H20 + 02 S02 + S03 + 6HF
FIG. 3 shows an exhaust gas **treatment apparatus** according to a third embodiment of the present invention.

As shown in FIG. 3, the exhaust gas **treatment apparatus** comprises a gas **treatment** reactor 13 into which a heating oxidative **decomposing** section, a catalytic reaction section, and a post-**treatment** section are integrally combined. The exhaust gas **treatment apparatus** has a fan scrubber 14 in a pre-**treatment** section. Scrubbing water is supplied to the fan scrubber 14 by a conveying pump 15.

... components, water
soluble components, or hydrolytic components are removed from the exhaust gas.

The gas **treatment** reactor 13 serves as a heating oxidative **decomposing** section, a catalytic reaction section, and a post-**treatment** section. Specifically, the gas **treatment** reactor 13 has a heating oxidative **decomposing** section 16, a catalytic reaction section 17, and a post-**treatment** section 18, in the downstream order of the flow of the exhaust gas. Thus, the heating oxidative **decomposing** section 16, the catalytic reaction section 17, and the post- **treatment** section 18 are integrally combined with each other to make the apparatus compact. Further, with... ...heated to 700
to 9000C by an electric tube furnace 19 in the heating oxidative **decomposing** section 16 can be introduced into the catalytic reaction section 17 without being lowered in... ...requires only a heat insulator 20 disposed therearound.

As shown in FIG. 3, the gas **treatment** reactor 13 has an ...level of distilled
water by a water purifier 23 and then supplied to the gas **treatment** reactor 13. The water introduced into the gas **treatment** reactor 13 flows through a water vaporization pipe 25 disposed outside of the outer surface of the electric tube furnace 19 in the gas **treatment** reactor 13.

At this time, the water is heated and vaporized by heat exchange with exhaust heat of the electric tube furnace 19 and then introduced into the heating oxidative **decomposing** section 16 disposed at an upper portion of the gas **treatment** reactor 13. The post-**treatment** section 18 having a water spray 18a is provided at a lower porti on of the gas **treatment**

reactor 13, and scrubbing water is supplied to the water spray 18a in the post-**treatment** section 18 by the conveying pump 15.

The exhaust gas to be treated passes through the fan scrubber 14 for pre-**treatment**, then passes through a mist separator 26, and is introduced into the gas **treatment** reactor 13. The exhaust gas from which HF has been removed in the post-**treatment** section 18 passes through a mist separator 27, and is discharged as a harmless gas... ...decomposition of PFC. In the present embodiment, water (H20) is introduced into the exhaust gas **treatment** system in a vaporized state. If the water contains Si or Ca. then Si or...water such as pure water or distilled water. Accordingly, it is necessary to provide an **independent** pipe only for supplying pure water or distilled water to the apparatus, and also to cost for providing pipes and the like can be eliminated.

A method of **treating** an exhaust gas according to the present invention will be described below.

In the pre- **treatment** process, powdery components, water-soluble components, or hydrolytic components are removed from an exhaust gas containing fluorine compounds and CO. The pre-**treatment** section for removing powdery components, water-soluble components, or hydrolytic components from the exhaust gas...from which powdery components, water-soluble components, or hydrolytic components are removed in the pre-**treatment** process is brought into contact with 02 and water (H20) at a temperature ranging from... ...more carbon atoms are decomposed. The heating oxidative decomposition is performed by the heating oxidative **decomposing** section, which has a hollow member for allowing the exhaust gas to pass therethrough, a...inlet port for 0 2 and an inlet port for water (H20) The heating oxidative **decomposing** section should preferably have an additional device for enhancing the efficiency of contact of the the exhaust gas, for thereby enhancing the efficiency of heating. Thus, the heating oxidative **decomposing** section can be made small in size, and can use a heater having a small... ...gas (HF) which has been produced when fluorine compounds are decomposed in the heating oxidative **decomposing** section is removed from the exhaust gas. The removal of HF is performed by the post- **treatment** section such as an adsorption tank for adsorbing HF into an adsorbent, a fan scrubber...exhaust gas may be brought into contact with 02, water (H20) and a catalyst for **decomposing** fluorine compounds at a temperature ranging from 600 to 900'C to thus decompose fluorine for **decomposing** fluorine compounds, and a heating device for heating a catalyst layer

to a temperature ranging... ...the gas which has been heated to 700 to 9000C in the preceding heating oxidative **decomposing** section at a temperature ranging from 600 to 9000C.

The system... ...water producing apparatus, a distiller, or a filter mechanism for purifying water (H20) used for **treatment** of the exhaust gas. The system should preferably comprise a mechanism for vaporizing water (H20) supplied in a liquid phase by heat exchange with exhaust heat of the heating oxidative **decomposing** section or the catalytic reaction section.

With this mechanism, since the exhaust heat is utilized... ...fillings made of ceramics at the downstream side of the catalyst layers. When the post-**treatment** section has a water spray, and the catalytic reaction section and the post-**treatment** section are integrally combined with each other. water sprayed from the water spray is prevented...Since the water is held in spaces between the fillings, HF produced in the PFC **decomposing** process can ef f iciently be brought into contact with water, and hence, the rate... ...f ect of the exhaust gas can be increased.

Next, test results of exhaust gas **treatment** with a testing apparatus equivalent to the exhaust gas **treatment apparatus** shown in FIG. 3 will be described below. An N2 gas mixed with various types...ml/ min and introduced into the testing apparatus. Air was introduced into the heating oxidative **decomposing** section at a flow rate of 3. 0 l/min for supplying 02 required for oxidation.

Similarly, pure water was introduced into the heating oxidative **decomposing** section at a flow rate of 5 ml/min for oxidation and decomposition.

The concentration... ...at an inlet port of the testing apparatus (location A), an outlet of the pre-**treatment** section (location B), an outlet port of the heating oxidative decompos J ng section (Location C) , and an outlet port of the post-**treatment** section (Location D) as listed below.

Component Location A Location B Location C Location D...from the above results that SiF4 and HF were not substantially detected in the-pre-**treatment** section and hence, an acid gas can efficiently be treated by the pre-**treatment** section. It can also be seen that CO, C4F8 . C5F8, C4F6 . CHF3 . and NF3 were not substantially detected in the heating oxidative **decomposing** section and hence, such gases can efficiently be treated by the heating oxidative **decomposing** section. Further, CF4 and SF, which had been detected at the outlet port of the heating

oxidative **decomposing** section were not detected at the outlet port of the post-**treatment** section. Thus, CF4 and SF, can efficiently be treated by the catalytic reaction section and the post-**treatment** section. Further, HF was not detected at the outlet port of the post- **treatment** section. Therefore, even if HF is produced in the catalytic reaction section, HF is efficiently treated by the post- **treatment** section.

FIG. 4 is a perspective view showing an exhaust gas **treatment apparatus** according to the present invention.

The exhaust gas **treatment apparatus** shown in FIG. 4 may comprise all of the pre-**treatment** section, the heating oxidative **decomposing** section, the catalytic reaction section, and the post-**treatment** section. With such an exhaust gas **treatment apparatus**, water-soluble components .

hydrolytic components, or powdery components, such as an acid gas and NH3... ...PFC and CO from an exhaust gas at a low cost. Thus, the exhaust gas **treatment apparatus** according to the present invention has a high removal capability of reactive components and harmful components discharged from a semiconductor fabrication apparatus or the like. Further, the exhaust gas **treatment apparatus** has a compact structure.

and hence, requires ...installation and maintenance. Thermal NOx or the like is not discharged from the exhaust gas **treatment apparatus**, and the exhaust gas **treatment apparatus** ensures absolute safety, i.e., is remarkably safe as a device.

In the above example, the exhaust gas **treatment apparatus** comprises all of the pre- **treatment** section, the heating oxidative **decomposing** section, the catalytic reaction section. and the post-**treatment** section. However.

the pre-**treatment** section and the post- **treatment** section may be provided separately from the exhaust gas **treatment apparatus**. Further, a post-**treatment** section may be provided for a plurality of exhaust gas **treatment** apparatuses, and may intensively treat an acid gas contained in an exhaust gas discharged from the plurality of exhaust gas **treatment** apparatuses.

As described above, according to the present invention, it is possible to efficiently and... ...fluorine compound and CO which is discharged from a semiconductor fabrication apparatus.

The exhaust gas **treatment** method and apparatus are

not limited to the illustrated examples. Although certain preferred embodiments of...

Claims:

1 A method of **treating** an exhaust gas containing at least one of a fluorine compound and CO, said method claim 1, further comprising <B>decomposing</B> the exhaust gas by catalytic reaction.
3 A method according to claim 1, wherein said 900'C.

6 A method of **treating** an exhaust gas containing at least one of a fluorine compound and CO, said method... ...more carbon atoms, ahydrofluorocarbon and NF3 in the exhaust gas.
7 An apparatus for **treating** an exhaust gas containing at least one of a fluorine compound and CO, said apparatuscomprising:a first <B>treatment</B> section for removing at least oneof a ...a water-soluble component and ahydrolytic component from the exhaust gas;a heating oxidative <B>decomposing</B> section forperf orming heating oxidative decomposition of said at leastone of said fluorine... ...CO to detoxif y the exhaustgas;anO2 supply for supplyingO2 to said heating oxidative<B>decomposing</B> section;an H20 Supply f or supplying H20 to said heatingoxidative <B>decomposing</B> section; anda second <B>treatment</B> section for removing an acid gasin the exhaust gas after the heating oxidativedecomposition.
8 An apparatus according to claim 7, further comprising a catalytic reaction section for <B>decomposing</B> the

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